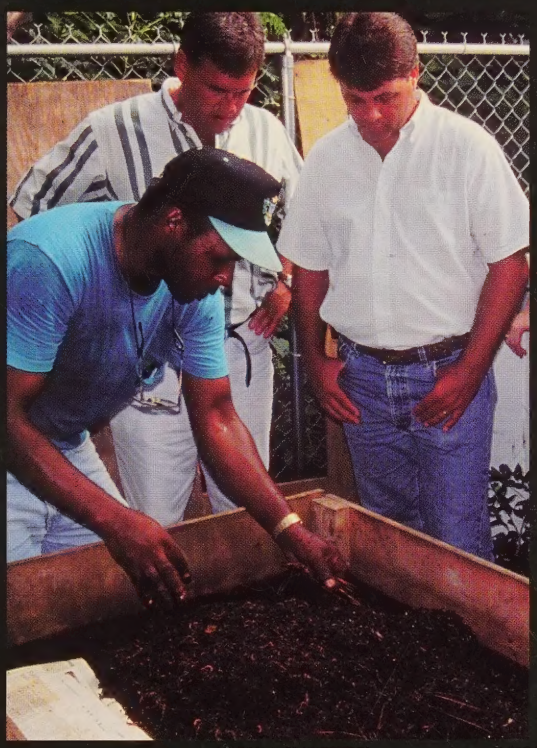
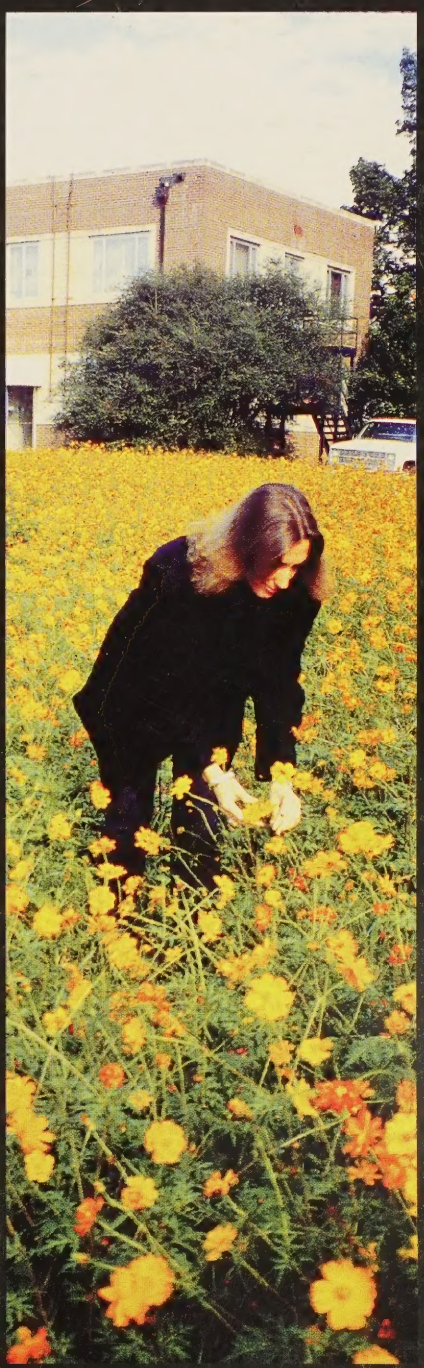
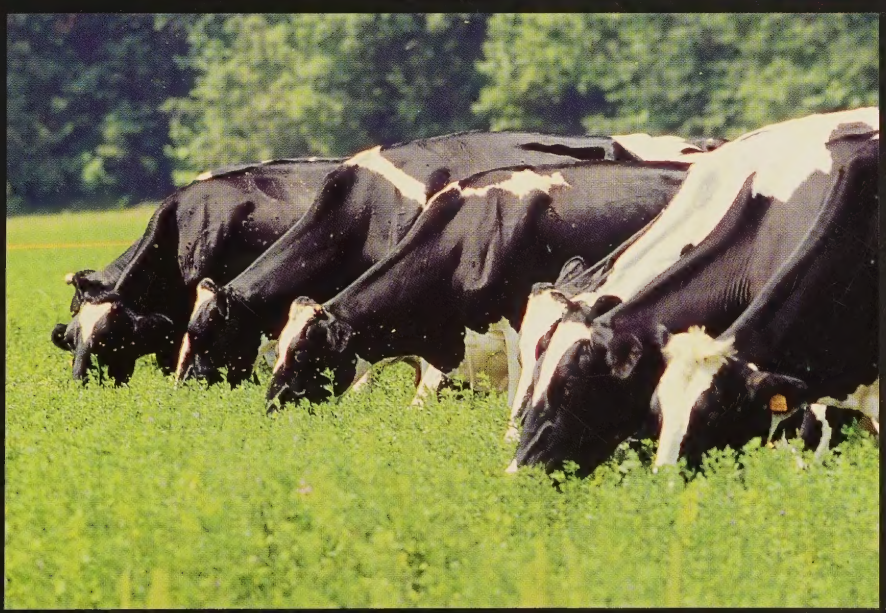
Southern Region SARE/ACE Program

Sustainable Agriculture Research and Education
Agriculture in Concert with the Environment

1995 Annual Report







Southern Region SARE/ACE

Cover photos:

Top left: Gourmet compost and the fishing worms that make it are turning into big business for Mike James of Florence, South Carolina. His super rich compost sells steadily at $4 per 10-pound bag. Now that he has discovered that earth worms can process heavy metals from soil, his business is attracting investment inquiries from as far away as England, Germany and Japan.

In this photo he is demonstrating the workings of a worm bed to extension agents and other educators as part of SARE Extension Training Project LST94-6. Photo by project coordinator Jim Palmer.

Top center: While attending the Administrative Council meeting, Adell Brown gets a close up look at canola plots that are part of Project LS94-57. Administrative Council meetings include project site visits whenever possible. Photo by Gwen Roland

Center: Natalie Martinez-Ochoa of the Plant Disease Laboratory at Auburn University counts root galls caused by nematodes as part of a project addressing IPM techniques in Florida and Alabama (LS93-51). Photo by Nancy Kokalis-Burelle.

Right: Evaluating low-input landscapes for the Southeast, entomologist Kris Braman heads up a interdisciplinary team of researchers from the University of Georgia's Agricultural Experiment Station in Griffin and the research division of TruGreen ChemLawn. The researchers are comparing the relative costs and benefits of landscapes based on pest resistant plants versus landscapes using common pest susceptible plants (AS95-23). Photo by Gwen Roland.

Bottom left: It's heads down on Tom Trantham's South Carolina dairy farm, where Holsteins graze on nine different paddocks at the time each paddock is at peak lushness. Reduced feed costs and improved herd health have resulted from Project LS93-54. Photo by Mark Keever.

Contents

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Acknowledgments

The Southern Region 1995 Annual Report is accomplished through a cooperative effort in keeping with the SARE/ACE philosophy.

Writing, editing and design were done by Gwen Roland. Project summaries were written by the project coordinators. Project photos were taken by project participants or Gwen Roland. Printing was done by McLaurin Graphics of Jackson, Georgia.

A Warm Welcome

Production and yield are no longer the measure of successful agriculture. Farmers once were judged by how many bushels of corn they grew per acre or pounds of milk their cows produced. Today we have broader concerns about how agriculture affects both our environment and our quality of life.

SARE/ACE is a unique program that recognizes that farmers make decisions based on multiple factors. That's why it concentrates on funding systems research that includes farmers as major participants and decision makers.

I have participated as a farmer cooperator conducting research on my dairy and now as chairman of the Administrative Council. In both roles, I have seen how profound change can be accomplished by small steps.

Pull up a chair, pour a glass of milk and take time to browse through the following project summaries for a first-hand look at our progress.

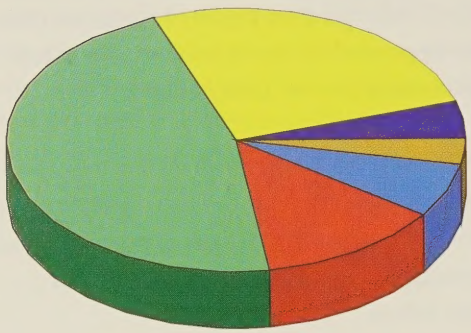
Tom Trantham, Chair
Administrative Council

Above: The Sea Islands Farmers Co-op in South Carolina is evaluating their marketing strategy and implementing new marketing techniques with the help of a Producer Grant. The farmers grow and sell produce and cut flowers. Since the start of their SARE project they have developed several new markets along the Eastern Seaboard (PG94-5).

Right: Special weevils are helping control musk thistle in areas of Illinois, Georgia, Tennessee and Kentucky thanks to a project that helped them spread from insectaries at Virginia Tech. Here Paris Lambdin deposits weevils into a thistle bloom alongside a Tennessee highway (LS94-64)

The Big Picture

1995 SARE/ACE Budget



Total budget $ 2,654,686

- Producer Grants $122,604
- Extension Training Grants $693,806
- ACE Grants $342,000
- Administration $176,210
- Meetings $86,000
- SARE Grants $1, 234,066

SARE was initiated in 1988 and is currently authorized under Chapters One and Three, subtitle B of title XVI of the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA) to promote research that expands knowledge about sustainable agriculture systems. ACE was started in 1991 when the USDA and the EPA cooperated in a new grants program with an emphasis on pollution prevention.

The Southern Region consists of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, Texas, Virginia and the U.S. Virgin Islands.

Funding priorities for the Southern Region SARE/ACE Program are shifting away from component research into whole systems research that investigates entire watersheds and landscapes.

Such projects require cooperation among various academic disciplines, institutions, agencies and even states. Subsequently, they also require a higher funding level and more time to design, implement and evaluate than does component research. Photo courtesy of Progressive Farmer Magazine.

Program Goals

The mission of the Southern Region SARE/ACE program is to stimulate research and education activities that will increase knowledge and extend information about sustainable agricultural systems.

The Southern Region SARE/ACE program accomplishes this mission by funding:

Research projects that investigate the scientific basis for sustainable agriculture;

Education projects that expand and extend our knowledge of sustainability to farmers, consumers, researchers, educators and policy makers; and

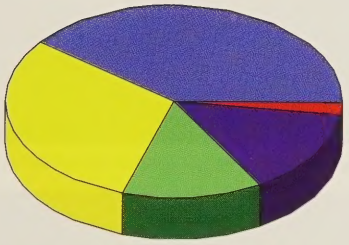
Producer projects that recognize that farmers are innovators and repositories of knowledge about sustainable agriculture.

Research and Education Subjects

Funding to date $6, 733, 959

- Pest management 19.15%
- Forest/wildlife 7.93%
- Rural development 6.06%
- Economics/ marketing 5.9%
- Cropping systems 27.06%
- Livestock systems 14.43%
- Waste management 19.5%

Extension Training Subjects

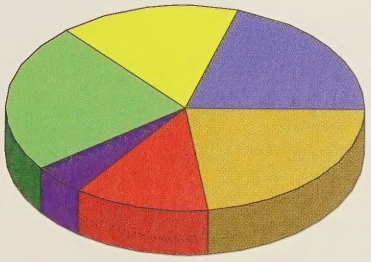


Funding to date $503, 620

(At the time of publication, the 1995 projects had not been awarded)

- Training consortium 39.64%
- Rangeland 14.41%
- Grazing 30.47%
- Cropping 2%
- Concepts 13.5%

Producer Subjects

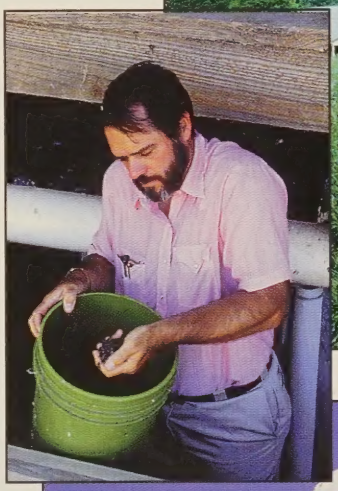


Funding to date $228,166

- Alternative systems 20.3%
- Waste management 12.2%
- Vegetable systems 16.3%
- Pest management 22.9%
- Grazing 4.7%
- Soil conservation 23.6%

Research and Education Projects

Since its beginning in 1988 the SARE/ACE program has invested more than nine million dollars to fund research and education activities in sustainable agriculture throughout the South. The goal of the Research and Education Grants, according to Federal guidelines, is to support mission-oriented projects that obtain data, develop conclusions, demonstrate technologies and conduct educational activities that promote sustainable agriculture.



Above: Field technicians in Texas install porous ceramic cup suction lysimeters for collecting soil water samples from switchgrass plots that will be irrigated with dairy wastewater (AS94-14).

Far right: Bev Eggleston uses a pig plow system to prepare tilled terraces on his diversified Virginia farm. He is cooperating with researchers on a comparison study of mulch materials for vegetables (AS93-7).

Right: After eating their fill of poultry droppings, a handful of manure munching soldierfly larvae have successfully navigated Craig Sheppard's experimental collection system. They can now be harvested for use in livestock feed (AS93-9).

Bottom: Wayne Reeves and Rachel Kingery examine a white lupin with superior cold hardiness that shows great promise as a forage rotation crop (LS93-53).

Research and Education Project Summaries

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Sustainable Agriculture Research and Education
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LS91-37
Final Report
December1995

Low-Input Crop and Livestock Systems for the Southeastern United States

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Ann Zajac
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Curt Laub
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All above from Virginia Tech

R. Philip Hanes
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Grayson County, VA

Project area

Whole farm systems

Project duration

January 1992-April 1995

Budget:

SARE	$360,000
ACE	
Matching	$425,000

Objectives

This was a long-running, interdisciplinary, multifaceted research and education project funded by the USDA LISA Program from 1988-1990 and the SARE Program from 1991-1993 (extended to 1995). It consisted of three major components:

1.) A long-term whole farm systems research project involving crops and livestock.

2.) An on-farm systems demonstration.

3.) The development and implementation of a low-input corn production system.

The overall objectives were to develop and evaluate crop/livestock farming systems that minimize reliance on non-renewable inputs while maintaining crop and animal productivity, maintaining economic viability, improving long-term soil productivity and minimizing undesirable environmental impact.

Whole Farm System

The first component, the whole farm systems research project, was an interdisciplinary research and education farming systems project, begun in 1989 and located at the VPI&SU Kentland Research Farm, Blacksburg, Virginia, USA. Although the SARE funding period is over, the farming systems project will continue as long as funds can be obtained to support it.

It is a replicated farm-scale experiment designed to compare a conventional crop/livestock system with an experimental, alternative, sustainable system to produce cattle of desirable slaughter weight and grade. Each system involves 48 steers per year and 80 acres of crop and pasture land.

The conventional system uses technology currently recommended by state Cooperative Extension specialists and practices currently used by producers in Virginia. The sustainable system uses grazing management for pest control and nutrient management as well as improved animal performance. Crop production includes rotations, use of legumes, development and demonstration of reduced chemical input corn production practices, use of conservation tillage systems, winter annual cover crops, and integrated pest management practices for weed and insect pests.

Results to date have demonstrated that nitrogen inputs can be reduced by one half or more with no reduction in crop or livestock production. By the ending date of the SARE project period the sustainable system had dramatically reduced requirements for pesticides while maintaining crop productivity and weed control.

Effects of grazing system on internal parasites in steers is being investigated. Animal production was slightly higher for the conventional system during the first two cattle cycles but this has reversed and steers on the sustainable system have had higher gains during the third, fourth, and fifth cattle cycles.

Crop rotation on the sustainable system has successfully controlled western corn rootworm at a savings of about $15/acre since a soil insecticide has not been necessary. Profitability of the two systems has been similar thus far but a longer time period will be necessary to access risks.

Grazing System

The second component of this project was a complementary on-farm grazing systems demonstration project established on a cooperative farm in Southwestern Virginia. Although the project funding period is over, the grazing system on the River Ridge Farm is now in place and continues with significant matching financial support from the cooperating farmer. Intensive grazing management, the use of legumes vs. nitrogen fertilizer and the sequencing of various forage species for year-round grazing were implemented.

Systems are being designed to demonstrate profitable beef production on steep hill lands in systems that promote nutrient recycling with reduction of external chemical inputs, avoid runoff and erosion, and maintain stable stream banks and clean water. Effects of grazing management on stream bank erosion and water quality are being investigated at this location.

The third component of this project involved the development and demonstration of sustainable corn production practices, including the use of conservation tillage systems, winter annual legume cover crops, and integrated pest management practices for weeds and insect pests.

Test-demonstrations were conducted on farms throughout Virginia. Research results from the whole farm systems project as well as component research conducted as a part of this effort has demonstrated that corn can be produced

using reduced herbicides and pesticides while maintaining yields similar to those achieved by conventional no-till corn production techniques.

Strategic grazing of the cover crop prior to corn planting may offer additional benefits in weed control and increased corn plant populations.

Educational programs for growers, extension agents and others are coordinated through the Virginia Tech/Virginia State Cooperative Extension Service, and consists of several approaches: multi-county field days, the annual Virginia Conference on Sustainable Agriculture, winter grower meetings, Extension agent training tours and workshops in sustainable farming practices and systems, tours of the ongoing research and test-demonstration project. Fourteen graduate students have worked on thesis and dissertation research projects that are subcomponents of this overall project.

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LS91-39A
AS93-10
Annual Report
December1995

Use of Poultry Litter as a Soil Amendment in Southern Row Crop Agriculture: A Feasibility Study Based on Agronomic, Environmental and Economic Factors

Project Coordinator
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Objectives

The goal of the project is to determine under what conditions producers of row crops in the Southern Region can profitably use poultry litter (PL) as a soil amendment. In order to accomplish this, we will:

1.) Quantify both the short-term and long-term agronomic value of poultry litter.

2.) Document the environmental consequences of land application of poultry litter in the row crop regions.

3.) Using the agronomic data on yield responses, estimate the farm level derived demand for poultry litter and poultry litter compost as a soil amendment; integrate the derived demands with costs of acquisition, transportation and application to determine the market feasibility of litter transport from areas of concentrated poultry production.

Poultry production in the U.S. is concentrated in the Southern Region. Disposal of poultry wastes via application to adjacent pasturelands has resulted in excessive fertilization of these soils which in turn has caused a deterioration of surface water quality in the poultry producing areas. Many of the intensively row-cropped soils of the Southern Region would benefit from applications of an organic material such as poultry waste, but these soils are typically far way from the poultry producing areas and the cost of transporting the waste is relatively high. Therefore, the goal of this study was to determine if broiler litter, a mixture of broiler feces and a bedding material such as wood chips, could be transported to and used by row crop farmers in Arkansas and Alabama in an environmentally benign and economically viable manner.

The above was reported in 1993. No report was submitted for this project in 1994 or 1995.

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George Dunklin
Henry and Tim Whitley
Jerry Yancey
David Johnson
Don Newbern
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All farmers

Project area

Waste utilization

Project duration

March 1993-Dec.1994

Budget:

SARE	$300,000
ACE	$100,000
Matching	$64,043

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LS91-40
LS94.40.1
Final Report
December1995

Utilization of Winter Legume Cover Crops for Pest and Fertility Management in Cotton

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The general concern with winter cover crops has involved a perception that pest problems in the summer crop would increase due to the cover crop, in particular legume cover crops. On the other hand, cover crops or attractive field borders may enhance the number and diversity of natural enemies reducing pest problems. Seven sites examined the benefits and risks from pests as a result of the use of winter legume cover crops in cotton production systems. Cotton using winter fallow in combination with reduced tillage was more profitable than cotton production with hairy vetch-reduced tillage. This research has established that an environmentally sound production system does not appear to increase pest problems and is economically sound.

Objectives

The general concern with winter cover crops has involved a perception that pest problems in the summer crop would increase due to the cover crop, in particular legume cover crops. On the other hand, cover crops or attractive field borders may enhance the number and diversity of natural enemies reducing pest problems. Seven sites examined the benefits and risks from pests as a result of the use of winter legume cover crops in cotton production systems.

Approach

The two long-term sites were Clarkedale, Arkansas, established in 1972, and Bossier City, Louisiana, established in 1955. All sites had the cover crop treatments hairy vetch and winter fallow. Tillage comparisons, conservation and conventional, were included at four sites. The entomology sites, Edisto and Foreman, included two hairy vetch treatments; 1) all cover crop incorporated, and 2) strips of hairy vetch allowed to mature.

Results

The data indicates that cover crops are generally pest neutral for insects, weeds, soilborne plant pathogens, and nematodes. The hairy vetch cover crop reduced populations of *Thielaviopsis basicola*, the causal agent of black root rot, compared to the winter fallow treatment.

Data also suggested that maintained strips of hairy vetch in the cotton crop are serving as a trap crop for thrips. The root knot nematode, *Meloidogyne incognita*, increased by the use of legume cover crops in 1992, but this response was not consistent over years.

These data are quite encouraging for the use of cover crops in commercial cotton production systems. Additional research is needed to quantify *Meloidogyne incognita* damage and develop management solutions, including timing of incorporation of the cover crop or identifying resistant legume cover crop species.

Improved soil and plant nitrogen status was detected from the use of a legume cover crop. The economic analyses of the sites indicate that the use of a hairy vetch winter cover crop under conventional tillage resulted in higher net returns than traditional winter fallow at five sites.

In addition, cotton production under conventional tillage was more profitable than the reduced tillage practices employed at two of the sites in this study.

Project area
Cover crops

Project duration
October 1991-Dec. 1995

Budget:

SARE	$304,000
ACE	
Matching	$420,255

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LS92-45
Final report
December1995

Organic Nitrogen Sources for Sweet Potatoes: Production Potential and Economic Feasibility

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Phil Loretan
Selected grower

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Farmer
Danny Bissett
Farmer
Both North Carolina

Project area
Cover crops

Project duration
Feb. 1991 - January 1994

Budget:

SARE	$105, 000
ACE	$15, 000
Matching	$50, 720

Objectives

1.) Evaluate yield, quality, and nitrogen cycling in sweet potatoes using crimson clover as an organic source of nitrogen in different soil types in the Southeast.

2.) Evaluate the effect of crimson clover as an organic N source on nitrogen use efficiency (NUE) of different sweet potato genotypes (including the effect of time of N availability relative to vine growth, storage root initiation and storage root bulking of individual genotypes) to determine potential for selecting for NUE.

3.) Evaluate the effect of crimson clover as an organic N source on sweet potato and corn yield and quality (including observational data on disease, insect and weed problems) in a two-year rotation cycle when replacing all or part of the N applied from inorganic sources in the two-year cycle.

4.) Determine the economic feasibility of using crimson clover as an organic source of nitrogen for sweet potato alone and in a two-year rotation cycle with corn.

Approach

Crimson clover, used as a winter cover crop, was tested as a source of nitrogen fertilizer to grow sweet potatoes. Winter green manures offer a more stable soil nitrogen supply due to the time involved in decomposition to release nutrients, and have the potential to decrease nitrate leaching. Clover resulted in yields equivalent to the commercially recommended rate of nitrogen fertilizer.

Measures of sweet potato quality, including the storability and sprouting of roots the following spring for plant production, were the same for clover and inorganic fertilizer. In one location root protein levels were lower resulting from the clover treatment than the fertilizer treatment, but since yields were the same, and there is no premium for protein, the value of the sweet potatoes was the same. In other tests crimson clover supplied as much or more N than the commercial fertilizer recommendation with no differences in root protein.

Crimson clover was also tested as a nitrogen source in two-year rotational systems of corn followed by sweet potatoes and sweet potatoes followed by corn. It was compared to no nitrogen fertilizer, half the recommended rate and the recommended rate for both crops and analyzed to see if there was any nitrogen carryover from one crop to the next that resulted in yield differences.

High indigenous nitrogen fertility of the soils resulted in yield decreases due to the addition of either source of nitrogen in the first year for the sweet potatoes. In the second year there were no differences in sweet potato yield for any of the nitrogen levels.

Corn fertility in the first year did not affect the performance of the sweet potatoes in the second year. Corn yield resulting from crimson clover incorporated just prior to corn planting was the same as the commercial nitrogen fertilizer rate in both years. However, there was a statistically significant reduction of corn yield following sweet potatoes grown using crimson clover in the first year of the rotation. Nitrogen levels in the grain were the same as in the fertilizer treatment, indicating that nitrogen was present during grain maturation, but the corn matured slightly earlier, suggesting a delay in nitrogen availability, and hence a lower grain yield.

This effect could not be separated out in the second test, and requires further investigation to see if it is consistent. Excluding this possible second year effect, crimson clover was sufficient as the sole source of nitrogen fertilizer for both corn and sweet potato production.

Results

An economic analysis on the sweet potato-corn and corn-sweet potato rotations revealed inconsistent results. This was due in a large part to the high nitrogen fertility of the soils, such that adding nitrogen fertilizer caused sweet potato yield reductions during the first year. The value and costs involved in sweet potato production were much greater than those of the corn such that the profitability (or lack of) of the sweet potatoes dominated the economic analysis.

The only two-year treatments that were better than using the commercial levels of nitrogen fertilizer were where sweet potatoes were grown in the first year with no nitrogen fertilizer. In the second year, where sweet potatoes followed corn, there were positive responses to nitrogen fertilizer. Adding no fertilizer was less profitable than adding some. The most profitable treatment was using crimson clover in the first year for corn followed by half the commercial rate of inorganic fertilizer for sweet potatoes the second year. This

resulted in a premium of $1,751 over the commercial practice of using nitrogen fertilizer for both crops.

The best rate of return per dollar was for the no nitrogen for corn - half nitrogen for sweet potato treatment, which returned $1,214 per hectare. Net economic gains of $1,000 or more per hectare were realized through nine of the 24 alternative nitrogen treatment-rotation strategies evaluated.

Fifteen of the twenty-four treatments resulted in a positive economic change compared with the current practice. A majority of the 15 positive net economic value changes (nine of 15) involved use of a cover crop as part of the alternative treatment.

Economic analysis of treatment data indicates that the use of crimson clover as a cover crop would benefit a large number of local growers who rotate corn and sweet potato in a planting sequence.

Another study was aimed at investigating the physiological mechanisms involved in nitrogen use by sweet potatoes. The response of sweet potatoes to nitrogen fertilizer was split into two components: how well the plant can recover nitrogen from the soil and how well it can convert that nitrogen into storage roots. Clones high in one component are not necessarily high in the other.

The concept behind this split is to pick the clones highest in each component and cross them to see if they can be combined into a higher yielding clone. When selection is based on yield only, some of the clones highest for one component are missed, and then so are some of the potentially best breeding combinations.

This study measured the nitrogen uptake and nitrogen utilization ability of several sweet potato varieties and found that there was variation among them for both components. An additional analysis was used to say which component was responsible for most of the variation, allowing breeders to focus resources on the component that will make the most difference. This was dependent on how yield was measured and on the level of nitrogen fertility.

Results suggest it is worth making crosses based on the nitrogen components to see if yield ability can be increased and the inheritance of these traits be determined.

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LS92-46
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Development of Cropping Systems for Nematode Management on Agronomic and Horticultural Crops

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Project area

Integrated systems

Project duration

Dec. 1992-Dec. 1995

Budget:

SARE	$155,000
ACE	
Matching	$84,350

Objectives

The project goal was to demonstrate the effectiveness and economic benefits of selected cropping systems for low-input, sustainable management of root-knot nematodes.

Specific objectives were:

1.) Develop and demonstrate the usefulness of selected tropical crops (short term) and forage crops (long term) in suppressing population densities of root-knot nematodes below damage levels.

2.) Provide information on crop yields, production costs, pesticide use, net returns, and financial risks due to adoption of these alternative crops.

3.) Determine the biomass added to the soil by each crop and the nitrogen mineralization following each crop.

4.) Demonstrate and test models of seasonal nematode multiplication on the alternative crops.

Approach and Results

Florida trials

Field experiments were conducted in north Florida (Suwannee County) from 1991-93 and in Alachua County in 1993-94. The crop sequences at the Suwannee County site were: *(i)* rotation crops during summer 1991; *(ii)* cover crop of rye during winter 1991-92; *(iii)* 'Lemondrop L' squash during spring 1992; *(iv)* rotation crops during summer 1992; *(v)* rye during winter 1992-93; *(vi)* 'Classic' eggplant during spring 1993. The eight summer crop rotation treatments were: 'Hale' castor, velvetbean, sesame, American jointvetch, weed fallow, 'SX-17' sorghum-sudangrass, 'Kirby' soybean, and 'Clemson Spineless' okra as a control. Rotations with castor, velvetbean, American jointvetch, and sorghum-sudangrass were most effective in maintaining the lowest population densities of two root-knot nematode species (a mixture of the Southern root-knot nematode and the peanut root-knot nematode), but stubby root nematode built up in the sorghum-sudangrass rotation. Yield of squash was significantly lower following sorghum-sudangrass than after any of the other treatments except fallow. Yield of eggplant was significantly greater following castor, sesame, or American jointvetch than following okra or fallow. Several rotation crops evaluated here may be useful for managing nematodes in the field and for improving yields of subsequent vegetable crops.

In Alachua County in the 1993-94 seasons, rotation crops of castor, velvetbean, 'Mississippi Silver' cowpea, 'Deltapine 51' cotton, and 'SX-17' sorghum-sudangrass were effective in maintaining low densities of the Southern root-knot nematode, whereas high population densities (greater than 450 per one-half pint of soil) resulted after 'Clemson Spineless' okra or 'Kirby' soybean. Similar patterns in densities of root-knot nematodes were evident in a crop of eggplant planted in the 1994 season following each of the rotation crops. The rotation crops planted during 1993 had little effect on yield of eggplant in 1994. Eggplant yield was inversely correlated with preplant densities of sting nematode, but not with the initial density of root-knot nematode.

Microplots (small field plots) were used from 1991-94 trying to determine the effects of 12 summer crop rotation treatments on population densities of the peanut and Southern root-knot nematodes and on yields of subsequent spring vegetable crops. The crop sequence was: (i) rotation crops during summer 1991; (ii) cover crop of rye during winter 1991-92; (iii) squash during spring 1992; (iv) rotation crops during summer 1992; (v) rye during winter 1992-93; (vi) eggplant during spring 1993. The 12 rotation treatments were: castor, cotton, velvetbean, crotalaria, fallow, hairy indigo, American jointvetch, sorghum-sudangrass, soybean, horsebean, sesame, and peanut. Compared to peanut, the first eight rotation treatments resulted in significantly lower numbers of the peanut root-knot nematode juveniles on most sampling dates. Soybean, horsebean, and sesame rotations were less effective in suppressing nematodes. Yield of squash was significantly greater following castor, cotton, velvetbean, and crotalaria than following peanut. Compared to the peanut rotation, yield of eggplant was significantly enhanced following castor, crotalaria, hairy indigo, American jointvetch, and sorghum-

sudangrass. Several of these rotation crops may provide a means for depressing the peanut root-knot nematode population densities on a short-term basis to enhance yields in a subsequent susceptible vegetable crop.

In 1993-94 the tests in microplots were designed to determine the effect of several candidate rotation crops on the Southern root-knot and stubby root nematodes. It is critical that rotation crops intended for suppression of individual root-knot nematode species be evaluated for their response to other nematode pests as well.

The fourth set of experiments was conducted in the greenhouse to determine the susceptibility of selected tropical rotation crops to two races of the Southern root-knot nematode (races 1 and 3), and the peanut and Javanese root-knot nematodes. The series of inoculation tests included 'Rutgers' tomato and (or) 'Clemson Spineless' okra as hosts susceptible to all of the nematode populations, and 'Florunner' peanut and 'Deltapine 90' or 'Deltapine 51' cotton were included as hosts susceptible only to the peanut root-knot nematode and race 3 of the Southern root-knot nematode, respectively. Horsebean, 'Sesaco 16' sesame, and 'Kirby' soybean exhibited intermediate levels of galling and egg mass production in response to several root-knot nematode populations. No egg masses were observed on crotalaria, 'Hale' castor, partridge pea, 'SX-17' sorghum-sudangrass, or 'Mississippi Silver' cowpea in any of the tests. Velvetbean had only a few galls and egg masses of the peanut and Japanese root-knot nematodes, but none from either race of the Southern root-knot nematode. The response of jointvetch was similar to that of cotton, with susceptibility only to race 3 of the Southern root-knot nematode. Since several tropical rotation crops showed resistance to several different root-knot nematodes, they may have potential use in cropping systems in the southeastern United States and other regions where these species and races of root-knot nematodes predominate.

Alabama Trials

Field experiments in Alabama were established at the Wiregrass substation (peanut), at the E. V. Smith Center (cotton), and in two producer fields near Elberta, Baldwin county. In addition, three microplot experiments were conducted in the 'Old Agronomy Farm' on the Auburn University campus.

Each experiment consisted of 8-10 treatments with eight replications (plots) each, arranged in randomized complete block design. Field plots (experimental units) were each eight row swide by 33 feet long; microplots consisted of a 1 $ft.^2$ area delimited with chimney flute as described in previous publications.

In each experiment data were collected on numbers of plant parasitic nematodes, disease incidence, and yield. All data were analyzed according to standard procedures for analysis of variance. Specific details varied according to the experiments but the methods followed are detailed in reprints included in the appendix to this report on file in the SARE office.

Castorbean and velvetbean were the most root-knot nematode suppressive and yield enhancing in rotations with peanut. Roots of both castorbean and velvetbean are known exude compounds that are nematicidal or nematostatic.

There is also evidence that the bacterial microflora of these plants is abundant in species antagonistic to root-knot nematodes. These results confirm findings in Brazil, Central America, and Mexico where the value of velvetbean to manage nematode and disease problems has been amply demonstrated. Velvetbean was once the premiere green manure crop in the South and was used in Alabama not only to improve fertility but also to manage soilborne pathogens and reduce weed problems.

Yield of peanut following sesame, hairy indigo, American jointvetch, or partridge pea were also significantly improved. Partridge pea was allelopathic to weeds so that plots with this legume were essentially free of this problem. Green manure production from hairy indigo and American jointvetch was outstanding, exceeding in most cases 10 MT dry matter/ha.

Sesame proved to be the most interesting rotation crop from an economical point of view. There is significant demand for the crop in the national and international markets. In 1994 two producers in Geneva County planted 700 acres of the crop with satisfactory results in spite of adverse weather conditions.

Results from soybean experiments in Baldwin County confirmed the value of velvetbean for the management of nematode problems. Yields of soybean following velvetbean were markedly improved. This was true for all cultivars tested in fields infested with a mixture of *Meloidogyne* spp. and the cyst nematode, *Heterodera glycines*. It is noteworthy that all cultivars tested in these experiments responded to the velvetbean rotation regardless of their level of resistance to the nematodes.

Bahiagrass pasture improved yields of cotton and soybean following it. This was true for all cotton and soybean cultivars tested. At the E. V. Smith center, the bahiagrass rotation improved the height and degree of mycorrhization of cotton plants and suppressed significantly fusarium wilt problems. These results corroborate earlier studies in Alabama and other southeastern states.

Microplot experiments at the Auburn campus demonstrated that castor, velvetbean and hairy indigo could be used advantageously to suppress root-knot problems and enhance yields of 'Black Beauty' eggplant following these crops.

In conclusion, our studies showed that:

1.) It is possible to increase crop yield and manage nematode and other soilborne disease problems by using crop rotations.

2.) Several "exotic" crops, e.g., sesame, velvetbean, can be used economically to improve yields in the southeastern United States.

3.) Rotation crops tested in our study can be incorporated into existing production system with minimal requirements in equipment or modification of cultural practices.

There remains need to determine the best cultivars and information on specific cultural requirements for optimal production of "exotic" crops under Alabama conditions.

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LS92-48
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Developing Environmentally Sound Poultry Litter Management Practices for Sustainable Cropping Systems

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Many broiler enterprises produce excess manure for environmentally safe recycling in cropping systems on available land under their control. Application rates and frequencies are often excessive. Including cover crops in rotational cropping systems, such as vegetables followed by grass forage for temporary grazing, hay, or silage, may enable producers to apply litter at higher rates more frequently and reduce nutrient losses due to runoff.

Objectives

1.) Evaluate the environmental and economic impact of broiler litter application rates and frequencies on selected vegetables.

2.) Investigate the feasibility of growing warm and cool season annual forage crops in rotational cropping systems to remove excess nutrients supplied by poultry litter.

3.) Determine nutrient loss due to runoff in a vegetable, forage, litter management system.

4.) Demonstrate economic litter management practices on grower-owned land under grower conditions.

Approach and Results

The litter rates applied for all objectives were based on soil test nitrogen (N) requirement of the crop and percent N content of the litter. Treatments were incorporated immediately after application by power tilling.

In objective 1, litter was applied at the recommended rate or at two or four times the recommended rate and either all preplant or half preplant and half side-dressed. Throughout the study, sweet corn was the spring crop followed by broccoli in the fall. Data were collected on crop yield, nutrient uptake, nutrient accumulation and nutrient leaching. This study indicates that producers could apply all the litter preplant or in split application without affecting growth or yield of either the spring or fall crop. Increasing litter application at more than twice the recommended rate decreased yield. Applying litter in excess of the recommended rate increases the risk of nitrate leaching into ground water. Regardless of rate applied, phosphorus (P) continued to increase in the surface six inches of soil. This suggests that non-point source pollution of surface waters might occur after years of continued applications of litter on sandy soils. Continuous litter application rates greater than recommended causes a subsequent increase in K concentration in the surface one foot of soil which can lead to negative effects on soil salinity and lower availability of magnesium. There is little effect from litter rate increase on Mg and Ca concentration in the surface one foot but does increase Ca at depths below three feet. Litter rate increase does not significantly effect soil pH. Neither litter rate or fertilizer blend caused any detrimental salt accumulation.

Treatments in objective 2 consisted of cropping system (spring veg.-fall veg., spring forage-fall veg., spring veg.-fall forage) with litter applied at either recommended two times the recommended rate. Litter was applied in the spring, fall, or spring and fall. Tomatoes were the spring vegetable crop followed by turnips in the fall. Sorghum-sudan was the spring forage crop with Elbon rye planted in the fall. Data were collected on yield, nutrient uptake, nutrient accumulation and leaching.

This study showed litter applications in both spring and fall increased yields of vegetable and forage crop. Producers utilizing a system of spring vegetables followed by fall forage could reduce leaching of nitrogen through the soil profile as well as reduce phosphorus accumulation in the surface six inches of soil. Applying litter rates sufficient to meet crop needs for N, regardless of cropping system or season of application, results in P accumulation that can lead to non-point source pollution of surface water.

None of the cropping systems studied had any significant effect on K or Ca. All cropping systems reduced Mg concentration at all soil depths while reducing soil pH in the surface one foot. A cropping system of spring vegetables followed by a fall cover crop reduces salt accumulation and leaching.

Regardless of the season in which litter is applied K, Ca and Mg concentration as well as soil pH decreases over time. Applying litter and commercial blend fertilizer in both spring and fall tends to increase salt accumulation and leaching below one foot.

Project area
Waste management

Project duration
Feb. 1992 - Jan. 1995

Budget:

SARE	$140,000
ACE	
Matching	$116,669

In objective 3, cropping systems of spring vegetable-fall forage, spring vegetable-fall fallow and spring vegetable-fall vegetable were studied. Fertility treatments consisting of a control, the recommended litter rate, four times the recommended rate and a commercial blend were applied.

The spring vegetable crop was sweet corn followed by broccoli in the fall. Sorghum-sudan was the spring cover crop. Elbon rye was seeded in the fall. Data were obtained on NO3-N and P accumulation, leaching and runoff.

The data indicated that a system of spring vegetables followed by a fall forage could reduce leaching and accumulation of N . Leaving the soil fallow in the fall increased NO3-N leaching . Regardless of cropping system used P will continue to increase in the surface one foot of soil .

A system of spring vegetables followed by fall cover greatly reduced the amount of NO3-N in the soil solution. Very little NO3-N and almost undetectable amounts of P were found in runoff water. This would indicate that incorporation of litter, which would be a normal practice under row crop production, would greatly reduce the chance of surface water pollution.

Demonstrations of litter use in vegetable production has increased grower awareness of this valuable nutrient source. Several are beginning to utilize this nutrient source in their operations. One grower in particular utilized litter in his intensive watermelon production program (mulch, drip irrigation) and realized yields of approximately 72,000 lbs/A. Another producer of greens and onions has begun incorporating poultry litter into his fertility program. A poultry producer diversified his operation by utilizing excess litter in a vegetable production program that supplies a local grocery chain with year-round vegetables as well as a roadside stand market.

Impact

Results of this study indicate a significant impact to sustainable agriculture. Poultry litter has been shown to be an excellent source of nutrients for crop production. If rates of litter are applied according to soil test results and litter nutrient content, yields can be maximized and environmental problems such as NO3-N leaching and accumulation minimized.

Including cover crops in a vegetable production system has a positive effect on reducing NO3-N accumulation and leaching, thus reducing the incidence of ground water pollution. A systems approach of using cover crops in a vegetable production program reduces the risk of contamination of surface water and ground water by NO3-N.

The information gained from this study will be beneficial to producers by helping them develop management plans that will qualify for Best Management Practices. Poultry producers will benefit by enabling them to dispose of a larger amount of waste product with less environmental impact.

There was one aspect that emerged from this study that could create a problem with the use of poultry litter as a fertilizer source. Regardless of litter rate applied or cropping system used, residual soil P continued to increase. This was most pronounced in the surface 0-15 cm (0-6 in) of soil. This is the zone most susceptible to runoff, thus increasing the risk of non-point source pollution of surface water.

Legumes are able to use significant amounts of P. An advantage of using legumes for removing excess P is that no additional N fertilizer has to be applied since legumes can obtain N from the atmosphere through N2 fixation. A study was initiated this spring (1995) to evaluate the use of warm- and cool-season legumes in rotational vegetable cropping systems to remove excess P supplied by poultry litter.

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LS92-49
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Organic Soil Amendments of Agricultural By-Products for Vegetable Production Systems in the Mississippi Delta Region

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Project area
Soil amendments

Project duration
January 1992-January 1995

Budget:

SARE	$140,000
ACE	
Matching	$ 64,579

There are ways to recycle and reuse agricultural wastes so they do not go to waste. This is particularly important in the South where agricultural waste products are so abundant. In Arkansas alone, the state's poultry and cotton industries produce billions of pounds of by-products and wastes each year. In 1993 Arkansas' billion broiler chickens produced 2 to 2.5 pounds of litter per bird. During ginning of the state's 1.5 million bales of cotton, 100 to 150 pounds of gin trash were produced per bale. In this project our aim has been to take advantage of the availability of these materials by putting wastes to work improving soils on small scale vegetable farms.

Objectives

University researchers and farmers worked together in this SARE/ACE project to evaluate availability, agroecological impact and economic feasibility of agricultural wastes when used as soil amendments. The bulk of the research/demonstration work was carried out on small scale vegetable farms operated by African American growers in eastern Arkansas' Mississippi Delta region. Farmers were directly involved in the planning of the research and implementation of the results. This allowed us to take research out of the controlled environment of the laboratory and agricultural research station directly to farms where people are growing crops.

Approach

Research has included work with animal manures and organic wastes from processing facilities such as cotton gins, rice mills and fisheries. Field studies began in 1992 at the Demonstration Farm of the Arkansas Land and Farm Development Corporation (ALFDC) in Monroe County, and the farms of Harvey Williams (Phillips Co.), Ben Anthony, Jr. (Lee Co.) and Jim Burton (Monroe Co.). Additional sites added in 1993 and 1994 were the farms of Randy Hardin (Jefferson Co.), Abraham Carpenter (Jefferson Co.), Arther Beam (St. Francis Co.) and Dennis Clark (Mississippi Co.).

Studies with aquaculture wastes have been performed at the University of Arkansas at Pine Bluff Agricultural Experiment Station.

Because of widespread interest by farmers on effects of poultry litter on vegetable production, much of the field work has involved evaluations with litter (manure + bedding material such as rice hulls) from broiler and turkey production. Several demonstrations were made with raw litter, but a composted pelletized form of litter was used on most of the replicated trials. Pelletized poultry litter (PPL) with NPK analysis of 4-4-4, has been evaluated with six farmer cooperators on cabbage, sweet potato, tomato, okra, basil, watermelon, broccoli, turnip and collard greens production fields. Benefits of using poultry litter have been most apparent in fields that previously had been precision leveled to improve irrigation efficiency. In these fields, topsoil has been disturbed and low pH (<6) is common. Significant crop responses also have been observed with shallow rooted plants (cabbage, collards, spinach) grown in light textured soils with low organic matter.

In several studies and demonstrations, we compared different sources of poultry manure (rates were adjusted to provide equivalent amounts of N). In replicated trials on the ALFDC farm with cabbage, no differences in yield were apparent between treatments of raw hen manure, pelletized hen manure, pelletized litter, composted litter and raw litter. Although the pelletized products are easier to store and apply, high costs of these value-added manure products precludes their use by many farmers.

Low-cost agricultural wastes most available in the Delta are rice hulls and cotton gin trash. Our replicated trials with gin trash and rice hulls included studies to determine effects of cotton gin trash (raw and composted) and cover crops on yield of cabbage, broccoli, southern peas, snap beans and cucumbers particularly with marginal soils. Significant problems with weeds and plant disease resulted in green beans following use of raw gin trash. Composting alleviated these problems and we found that composting didn't have to require huge inputs of time by the farmer to produce an amendment that could improve productivity of the soil.

Ben Anthony routinely hauls gin trash in his pick-up truck from a local gin to his cattle pas-

ture where cows feed on the material over the winter. By summer's end the trash has decomposed. We applied this decomposed (composted) gin trash to damaged soil on his vegetable farm in 1994. Four tons/acre increased earliness and yield of his spring transplanted cabbage. In fall trials that year with turnips at the ALFDC farm, applications of two tons per acre of this composted gin trash + fertilizer (60 lb N/A provided with 13-13-13) resulted in significantly higher yield of greens compared to plots receiving fertilizer alone.

Additional studies with composted gin trash have included using the material as a potting media for growing watermelon and tomato transplants on the Ben Anthony Farm. Mixed in a 2:1 combination with perlite, tomato and watermelon transplants grown in composted gin trash were equivalent in plant height and color to plants grown in standard potting media; however root development was reduced compared to the standard. This resulted in significant problems pulling the plants during high speed transplanting with mechanical transplanters.

In watermelon field trials on the Clark and Anthony farms, once transplants were set, there were no differences in yield or quality in final harvests. In other work, composted gin trash was found to be a good material for production of potted ornamental plants, Swedish ivy and wandering Jew.

No significant improvements in yield of cabbage or collards have been observed with applications of raw rice hulls. The negative effects of over application of raw rice hulls were demonstrated on the ALFDC farm with spring transplanted cabbage when rates up to 10 tons/acre of raw hulls resulted in nutritional deficiencies (primarily N). This demonstration was valuable to several farmers and area Extension agents who had routinely recommended high amounts of rice hulls for garden plots.

Work with aquaculture wastes has included construction of composting units at the University of Arkansas at Pine Bluff Aquaculture Research Station. Applications of composted fish remains and spoiled feed were evaluated on the UAPB research farm in replicated trials with collards and southern peas. Hairy vetch and rye were evaluated as winter cover crops in combination with compost. Cover crops had varying effects on southern pea yield in three years of trials, but there was no significant differences in yield. Results have been variable with collards, but significant increases in yield of spring transplanted collards were observed in 1994 following application of two tons compost/acre.

Education and outreach have been an important part of our project. The ALFDC has been instrumental in these efforts sponsoring several workshops, field days and conferences including the ALFDC Annual Conference in Fargo, AR held each October. In 1994, our research was highlighted in a special sustainable agriculture section held during the conference, which included tours of research plots. Additional field days were conducted on the Ben Anthony and Abraham Carpenter farms. Project results have been presented at a number of professional and grower meetings including the 1995 Southern Sustainable Agriculture Working Group Annual Conference, and annual meetings of the Arkansas State Horticultural Society and the American Society of Horticultural Science.

Results

In this project, we have found that benefits from applying low-cost agricultural waste products include improvements in soil productivity, making possible increases in farm profitability. The most outstanding results have been observed with crops grown on land that had been recently precision leveled and with crops with shallow root systems. An additional benefit is the contribution to solving waste disposal problems confronting the region.

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LS93-51
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IPM for Nematode Disease Control in Vegetable and Agronomic Crops in Florida and Alabama

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Objectives

The potential use of a warm-season forage grass for controlling peanut pests and for use as livestock feed offers a novel approach to sustainable agriculture. The principal rationale of this research is that switchgrass can be used as a forage grass rotation to enhance sustainability of farms engaged in mixed peanut/cattle production.

The long-term goal of this project is to develop profitable and sustainable peanut production systems that will suppress nematodes and other soilborne pathogens, reduce or eliminate pesticide use and enhance cattle production.

Specific objectives are to

1.) Assess the potential of peanut rotations with switchgrass to suppress infection by root-knot nematodes, aflatoxigenic fungi and other soilborne pathogens of peanut within integrated peanut and forage-livestock production systems.

2.) Study the effect of selected warm-season forage grasses on populations of nematodes, aflatoxigenic fungi and other soilborne pathogens of peanut.

3.) Evaluate the level and variability of implied net returns from all treatments if adopted on a commercial scale.

4.) Determine the impact of switchgrass and other selected warm-season forage grasses on beneficial soil microbial communities.

Methods

Field trials were established in 1992 for rotation/production system studies. These three year rotations included continuous peanut, switchgrass-peanut, continuous switchgrass, cotton-peanut and cotton-cotton-peanut. Peanut and peanut-switchgrass rotations were planted both with and without nematicide (aldicarb) as an industry standard control. Field trials were used to assess the potential of switchgrass rotations to suppress root-knot nematodes and aflatoxigenic fungi and to assess microbial population shifts with crop rotation under field conditions.

Nematodes were sampled prior to harvest, when populations are highest. A flatoxigenic fungi were assessed at two week intervals throughout the growing season. Soil microorganisms were sampled at three times during the growing season. Evaluation of shifts in microbial populations and species diversity were used to assess environmental impacts and sustainability of forage grass rotations for disease control. Yield data were collected from field experiments.

A series of microplot experiments was established to more closely investigate the effects of forage grass-peanut and forage grass-cotton rotations on nematode populations and soil microorganisms. Microplots were sampled for nematodes at planting and before harvest. Methods utilizing nematode eggs in alginate films were developed that allowed for the evaluation of the effects of shifts in soil microbial ecology with cropping system on nematode eggs in microplots.

Enterprise budgets are being developed using yield and input data. Enterprise budget computations are made across all treatments and replications. Net return results are analyzed to determine differences in potential business profits. Analyses includes business returns for existing producers as well as new entrants. Procedures will be used to trace the trade off between return levels to return variability. Results will allow conclusions to be drawn concerning adoption of nematode control strategies by risk averse, risk neutral, risk seeking entrepreneurs.

Results

The results of nematode isolations indicate that in field trials, switchgrass and cotton did not support populations of root-knot nematode. Switchgrass supported higher populations of nonparasitic (beneficial) nematodes than cotton. Peanut with no nematicide following two years of switchgrass provided the same nematode control as continuous peanut plus nematicide.

Experimental results do not lead to any firm conclusion that switchgrass rotations can minimize invasion of peanut seed by aflatoxigenic fungi. However, the data does support the hypothesis that particular rotation sequences can contribute to minimizing peanut seed invasion by aflatoxigenic fungi and subsequently minimize aflatoxin contamination of the peanut crop.

Microbial populations in field trials indicate that switchgrass supported lower numbers of rhizosphere fungi than peanut throughout the season and a distinctly different bacterial microflora compared to continuous peanut and peanut following switchgrass. These shifts in bacterial populations are consistent with previous results

Project area

IPM

Project duration

March 1993-Dec. 1996

Budget:

SARE	$16,000
ACE	
Matching	$11,700

where similar shifts resulted in soils being suppressive to one or more pathogens, including root-knot nematodes and *Sclerotium rolfsii*.

Results of microplot studies indicate that switchgrass reduced egg viability and juvenile emergence, increased the number of eggs parasitized by fungi or bacteria and reduced the number of root-knot nematode juveniles in soil compared to peanut or cotton in microplots.

Overall, alginate films containing eggs placed in microplots planted to grasses had fewer viable eggs and more parasitized eggs than films placed in plots with peanut, indicating an altered soil microflora antagonistic to nematode eggs. Significantly fewer J2 hatched out of eggs from films placed in grass plots.

Peanut yield did not differ among treatments in field plots in 1993 or 1994. Yield data was not available for 1995 at the time of this report.

Economic analysis indicates that in the present situation where farmers can sell quota peanuts at prices that are fixed by the USDA, the farmer would choose to plant half of his land in continuous peanut with nematicide and the rest in two years of cotton followed by additional (nonsubsidized) peanuts.

To compare this with switchgrass based rotation, the analysis forced only rotation patterns containing at least one year of switchgrass in the rotation practice. It was observed that the profit was reduced almost 1/3 of the former level. On the other hand, in this situation the farmer used much less chemicals.

The other conditions analyzed in this study was with the assumption of complete elimination of the peanut program. When quota was eliminated, farmers would still choose not to plant switchgrass because of lower profit potential. Because the farmer places higher utility to profit than environmental amenities, switchgrass was not included in the rotation practice. When switchgrass was forced into the rotation practice with a complete quota elimination situation, the farmer decided not to plant any crop.

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LS93-52
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Utilization of Dairy Manure in Low-Input, Conservation Tillage Animal Feed Production Systems

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Objectives

Scientists and farmers have known for decades, even centuries, that animal manures enhance the growth and yield of plants. However, relatively little has been done to enhance the producer's ability to utilize this important resource wisely. It is not uncommon for a dairy farmer to spread manure on his fields and then apply nearly full recommended rates of inorganic N (and P and K) to the field. If asked for a reason, most will indicate that they do not know how much N, P, or K was in the manure, so they must "insure" good yields through the application of inorganic fertilizers.

Over-application of nutrients poses at least two problems: first, excess nutrients can leach or runoff into water supplies, causing health problems or at least imbalances in aqueous ecosystems; secondly, applying inorganic fertilizers when manures are available is an economic loss for the farmer. Therefore, it is important to provide tools to make wise resource use decisions to save money and to improve environmental quality.

The objectives of this research project are to look at the long-term residual impacts of manure applications on corn silage growth and soil properties, as well as the impact of manure applications on off-site surface and subsurface water quality.

This is being accomplished through the use of field plots at two state agricultural experiment stations and two cooperator farmer locations. The experiment station sites are the Martin Agricultural Experiment Station in Martin (northwest Tennessee) and the Dairy Experiment Station in Lewisburg (south-central Tennessee). The plots at Martin have not received previous applications of manure, while the Dairy site has been manured frequently for nearly 40 years. The farm sites are both working dairies, one near Martin and the other south of Lewisburg.

Approach

In order to evaluate residual availability of N on manured plots, plots were established in 1993 at the Experiment Station sites and in 1994 at the farmer sites. The experiment at the experiment stations consists of 17 treatments: a 0-fertilizer check, three rates of N as NH_4NO_3 (84, 168 and 252 kg N ha^{-1}) and three rates of manure N (112, 224 and 336 kg manure-N ha^{-1}) applied for either:

1.) Three consecutive years, or

2.) Two consecutive years with no application in year three, or

3.) The first year with no application for years two and three.

To provide a tillage comparison, the 168 kg inorganic N ha^{-1} and the 224 kg manure N ha^{-1} treatments applied for one, two, or three years were established with conventional tillage (chisel + disk + harrow) and no-tillage.

Manure rates were derived using the assumption that 75 percent of the N applied as liquid cattle waste would be available for plant use in year one (Pratt et al., 1973). This results in an estimated availability of 84, 168, or 252 kg N ha^{-1} which matches the inorganic rates. The 168 kg ha^{-1} rate corresponds to the high end recommended rate of fertilizer N for corn in Tennessee.

Inorganic P_2O_5 and K_2O are applied to the inorganic fertilizer N plots according to soil test recommendations. Manures and fertilizers are applied prior to tillage and planting operations. Smaller versions of this experiment have also been established on two cooperator farm sites, one in each region. The treatments were scaled down to the following 11 no-tillage treatments: the 0-fertilizer check; the 168 kg NH_4NO_3 N ha^{-1} treatment; and the 112, 224 and 336 kg manure N ha^{-1} treatments for one, two or three years.

To evaluate manure impacts on water quality, a second series of plots were established at each station. Treatments at the Martin site include four rates of liquid dairy manure (126, 252, 380 and 504 kg N ha^{-1}), one NH_4NO_3 rate (218 kg N ha^{-1}) and a control (0 kg N ha^{-1}). At Lewisburg, the 380 kg N ha^{-1} manure treatment was omitted due to lack of space. The applications range from deficient to excessive N rates; however, the high application rate is not uncommon for dairy operators in these areas.

Corn for silage is no-till planted on all plots each spring, followed by an annual ryegrass-clover winter cover at Martin and orchardgrass cover at the Dairy Station.

Instruments have been installed beneath each plot (at a depth of three feet) to collect

Project area
Livestock systems

Project duration
March 1993-Dec. 1996

Budget:

SARE	$90, 635
ACE	
Matching	$36,123

water leaching through the soil and out of the root zone. After every storm, leachate is analyzed for nitrate-nitrogen and other constituents, such as phosphate.

Results

The data for the residual experiments indicate that prior manuring history will affect the availability of N. At Martin, yields of silage corn were much lower for second and third year corn grown on plots receiving manure only during 1993. For soils receiving manure for two years, the yields in the third year were still well below those for normal rates of inorganic-N applications (168 kg N ha-1). Manure applications of 224 or 336 kg N ha-1 for three years resulted in yields equal to those from the inorganic control. The soils at the Dairy Station have received manure for many years and have shown no response to added fertilizer or manure-N for the past three years. This site has been manured for nearly 40 years and illustrates the potential for over-application of nutrients when using both animal and inorganic sources of N simultaneously for a number of years.

Water quality monitoring at Martin has indicated that rates of manure nitrogen as high as 250 kg per hectare (225 lbs per acre) results in yields comparable to those using recommended rates of inorganic N fertilizers (approximately 168 kg per hectare) with no significant impact on nitrate-N concentrations in the leachate. Cumulative nitrate-N losses are much higher from plots receiving over 500 kg N per hectare per year and may pose a problem. Observations at the Dairy Station for the last few years indicate that there is appreciable N being made available from prior manure additions and leaching losses have occasionally been unacceptable even from 0 N control plots. Again, the data indicates that we will need to closely evaluate the previous history of a farm when deciding how much N or P we will add in any form.

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Sustainable Whole Farm Grain/Silage Production Systems for the Southeast

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Project area
Whole farm systems

Project duration
June1993-May1997

Budget:

SARE	$240,639
ACE	
Matching	$218,600

Objectives

1.) Develop profitable alternatives, using white lupin, tropical corn, and hybrid pearl millet to current grain and silage production systems employed by farmers in the Southeast.

2.) Develop sustainable systems utilizing these alternative crops that integrate into diversified (crop/livestock) farming systems and result in reduced pesticide and fertilizer inputs and conservation of soil, water and energy.

3.) Determine the profitability of production systems using these alternative crops as compared to traditional systems currently employed by farmers in the Southeast and disseminate this information to farmers through farm meetings, popular press articles, Extension publications, videos and television.

Approach

Coordinated experiments are being conducted at five locations in Alabama, Florida, and Georgia extending from the panhandle of Florida to the northern edge of the Coastal Plain in central Alabama. The core experiment is a cropping systems experiment of six cropping systems in conjunction with four rates of nitrogen (N) fertilizer applied to the summer crops in the systems.

Cropping systems are:

1.) Wheat/soybean
2.) Wheat/tropical corn
3.) Wheat/pearl millet
4.) Lupin/soybean
5.) Lupin/tropical corn
6.) Lupin/pearl millet

Nitrogen treatments on summer crops are 0, 60, 120, and 180 lb N/acre. This brackets recommended N rates for these crops under rainfed conditions.

The changes in amounts of nitrogen in the plant/soil system are being measured from the beginning of the study in 1993 until the end of the study in 1996. This will provide information on N utilization efficiency of the systems and allow inferences to be made as to losses of N to the environment via denitrification, runoff and leaching.

Whole plant samples of lupin, pearl millet, and tropical corn are collected at appropriate growth stages for each crop for silage yield determinations. Silage quality from these crops is determined (measurements of DM, ADF, NDF, IVDMD, CP and Ash). Ensiling evaluation (pH, DM, lactic acid in laboratory mini-silos) is made each year. Data collected includes yields and all production inputs and values necessary for accurate economic analyses. Enterprise budgets are being developed to determine the most economically viable cropping system.

In addition to the primary test, separate but coordinated studies include:

1.) Experiments to determine the optimum planting dates for tropical corn and pearl millet;

2.) Animal feed trials to evaluate silage of the three alternative crops—tropical corn, pearl millet, and lupin;

3.) Experiments to determine the effectiveness of the biological insecticide, *Bacillus thuringiensis* Berl., for control of fall armyworm in tropical corn;

4.) Characterization of potential insect pests of pearl millet;

5.) Evaluation and screening of new lupin germplasm;

6.) Evaluation of the potential forage value of new pearl millet hybrids;

7.) Determination of optimum soil pH and phosphorus needs of pearl millet;

8.) The role of phosphorus nutrition in seed quality of white lupin.

Results

The 1995 season results varied due to location and environmental conditions (all locations underwent severe drought stress) but data indicated that:

1.) Response of wheat grain yield to previous summer crop varied with location; at one location maximum yield (40 bu/A) was obtained following soybean, at another maximum yield (35 bu/A) was obtained following millet that had been fertilized with 120 lb N/A, and at another previous crop had no effect on grain yield (average 50 bu/A).

2.) Anthracnose disease outbreaks seriously reduced lupin grain yields and anthracnose may be a critical constraint to lupin production in the South. Lupin silage yields (35 percent dry matter basis) ranged from 2.4 to 4.5 tons/A but grain yields were low (2.2 to 11.8 bu/A) due to anthracnose.

3.) Lupin shows promise as an excellent food source for white-tail deer and this commercial possibility is being explored.

4.) Soybean yields were reduced 13 to 23 percent when double-cropped following lupin vs. wheat.

5.) Tropical corn silage ranged from 7.7 to 21.3 tons/A (35 percent DM) dependent on location, planting date, previous crop and N fertilizer rate. Grain yields were low due to the severe drought (24 to 78 bu/A) in the cropping systems study but yields of 105 bu/A were obtained in with late planting (and more favorable rainfall) in a planting date study.

6.) Drilled pearl millet plantings resulted in excellent silage and grain yields. Millet in rotation with lupin yielded from 36 to 43 percent greater grain than following wheat. Silage yields were also increased following lupin at all locations. Millet silage yields ranged from 10.0 to 27.5 tons/A (35 percent DM). Under severe drought stress, maximum millet grain yields were obtained with 60 lb N/A but under less severe stress, maximum estimated yields [from head lengths, plant populations, and seed weights from bagged heads to prevent bird damage] (129 bu/A) were obtained with 180lb N/A following lupin. Despite the poor performance of lupin this season, the positive rotational response it has on pearl millet may reduce economic risks with this cropping combination.

7.) Tropical corn and millet silage has similar energy and protein content to temperate corn silage and lupin silage is lower in energy but higher in protein than the other silages.

8.) Dry matter and nutrient accumulation patterns of lupin in relation to growing degree units have been determined and critical stages of plant development have been photographed to produce a mangement guide for growers.

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Evaluation of a Low-input, No-till, No-herbicide Continuous Grazing System for Dairy Cows

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Objective

The objective of this project is to evaluate the economic impact of implementing a year-round rotational grazing system utilizing sustainable agriculture techniques.

Approach

This project is being conducted by Clemson University at the Tom Trantham Dairy, located 35 miles from campus. Mr. Trantham milks approximately 70 Holstein cows twice per day. A system was designed with the goal of utilizing grazing during as much of the year as possible. Mr. Trantham's dairy consists of 95 acres, 50 of which are available for grazing the milking string. These 50 acres are divided into seven paddocks. Movable fence is used to further subdivide each paddock into subplots. The size of the subplots is dependent on the amount of forage available. Sustainable agriculture techniques are utilized including no-till planting and manure is the main source of fertilizer. Use of herbicides and chemical fertilizers has been minimized. The paddocks are rotationally grazed. This report includes results from the spring and summer crops of 1994 and the winter/spring crop of 1995. Crops grazed during the winter/spring were mostly cereal grains and ryegrass and crops grazed during the summer were sorghum and millet. A variety of alfalfa designed for grazing was established this year and results from it will be reported next year.

Number of days grazed per paddock per grazing period was minimized so that crop growth did not preclude accurate estimates of dry matter intake based on pre-graze and post-graze clippings. Cows grazed from one to five hours per day, depending on the forage supply. Cows were kept on each paddock for an average of 5.7 days. Once cows started grazing on March 15, 1994, they grazed 292 of the 419 days through October 16, 1995.

Dry matter and nutrients grazed were obtained by collecting 10 pasture samples immediately prior to grazing and immediately after grazing ceased. Samples were taken in a pattern so they were representative of the entire pasture. Each sample was obtained by clipping all forage growth contained within a two-foot by two-foot metal frame that was placed on the ground. Plants were clipped so that approximately 2 inches of stubble remained. Samples were transported to the laboratory and analyzed for nutrient content.

The advantage of grazing was determined by subtracting the estimated costs for feeding the herd without grazing from the actual costs of the feeding program utilizing grazing.

Results

Cows grazed 296 out of a possible 419 days, which is 71 percent of the possible days. They grazed the 1994 spring crop for 74 days, the 1994 summer crop for 65 days and the 1995 winter/spring crop for 32 days. Cows consumed an average of 9.6 pounds of dry matter from grazing on the days they grazed. This is approximately 25 percent of their dry matter requirement. This figure varied considerably, depending on the amount of available forage.

Quality of feed consumed

Cattle that graze consume a higher product than results if that crop is harvested. Cattle naturally choose the lushest, most nutritious parts of the plant and leave the least digestible parts. The average neutral detergent fiber (NDF) of the crop offered averaged 60.1 percent, but the portions that the cows ate were only 56.3 percent. This same trend is true for acid detergent fiber (ADF). ADF of the whole plant offered to the cows was 32.1 percent, but the ADF of the parts of the plant that were consumed was 29.7 percent. This indicates the cows ate the least fibrous portions of the plant. Conversely, the cows ate portions of the plant higher in crude protein (CP) than the whole plant contained, 23.6 percent versus 19.9 percent

The data illustrates one of the unique advantages of grazing. Had the cows been fed the same crops as harvested feed, they would have been fed a much lower quality product and would have had to expend energy digesting lower quality forage.

Cost Advantages of Grazing

When all costs associated with grazing were calculated, data for the first year and a half of this study showed that grazing saved an average of $.47 per cow per day on days when cows grazed. Since the cows grazed a total of 292 days out of 419, the total savings from grazing was $9,606.80 for an average of 70 cows.

Costs savings from grazing varied greatly

Project area

Livestock system

Project duration

March 1993- Dec. 1996

Budget:

SARE	$118,911
ACE	
Matching	$62,700

among pastures and ranged from -$.77/cow/day to $1.20/cow/day. Five pastures actually cost more than was returned from grazing. This was due to several factors including unfavorable weather conditions and poor pasture growth. Number of days the pasture was grazed appeared to be the largest determinant of cost savings.

Data to date from this study shows that grazing cows instead of feeding harvested feed can result in significant cost savings.

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Cover Crop Integration into Conservation Production Systems

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Participants continued on next page

Project area
Cover crops systems

Project duration
March 1993-Dec. 1997

Budget:

SARE	$135,540
ACE	
Matching	$117,040

The objectives of this project are to remove barriers to wider use of winter cover crops to build soil productivity, increase farm profitability and reduce adverse environmental impacts of row-crop production.

Objectives

This project will make cover crops more attractive by reducing their cost and developing easier ways of managing them. Specifically, the project seeks to:

1.) Identify legume cover crop germplasm with superior reseeding characteristics.

2.) Demonstrate practical management systems that reduce the need for herbicides in no-till and low-till crop production.

Approach

Cover crop nursery evaluations

Legume cover crop germplasm was screened at 11 locations representing a range of soil types and climate zones varying from the Gulf Coast to northern Tennessee and from Georgia to western Arkansas.

'Tibbee' crimson clover is used as a standard against which 17 other cover crops are compared, seeking a superior combination of winter hardiness, vigor, early maturity and hard seededness. Cooperators (farmers and researchers) plant the cover crops in observational plots and record vigor, flowering date and weather data and collect yield samples that are sent to the National Sedimentation Laboratory for nitrogen analyses.

The cover crops are killed in the spring at two dates controlled by the flowering of 'Tibbee' (the first, two weeks after 'Tibbee's first bloom and the second several weeks later). Reseeding success is determined the following fall. The reseeded populations are killed the succeeding spring before they can make additional seed and their ability to volunteer back for a second year from a single seed crop is determined.

Seed of a promising cover crop identified in this project, spotted burclover, is being increased in cooperation with the USDA-NRCS Jamie Whitten Plant Materials Center. Fifteen farmers responded to an offer in *Common Ground*, the newsletter of the Southern SARE/ACE program and samples of another promising cover crop, balansa clover, were distributed to them for evaluation on acre-sized areas.

Management system evaluations

Management systems being evaluated in replicated-plot and on-farm studies include demonstrating mechanical killing cover crops ahead of no-till planting cotton and other crops, testing planter attachments to facilitate the planting of cotton through the cover crop residues and evaluating the ability of the residue mulches to reduce weed competition with summer crops.

A mowing date study compared mowing vetch, rye, or rye plus vetch 0, 2, 6, 14, or 26 days ahead of no-till cotton planting in early May and tested four commercial residue management planter attachments.

A cover crop/weed control study compared four winter cover crops (vetch, rye, rye plus vetch, or volunteer vegetation) and four weed control treatments (ranging from no-till with broadcast preemergence and postemergence herbicides to a minimum herbicide treatment involving mechanical and flame cultivation) for cotton production. Soil temperature, cotton growth and weed populations are measured.

In on-farm evaluations, Steve Parks and Lorna McMahon tried no-till planting cotton into mow-killed wheat and vetch in Tiptonville, TN; David Denton tried no-till planting soybean into mow-killed rye or wheat plus winter peas, in Tyronza, AR; Jim Whitfield tried no-till planting cotton into living white clover mulch in Yazoo City, MS.

Results

Two promising new cover crops have been identified. Southern spotted burclover (*Medicago arabica*), appears to be well suited to the upland soils in much of the region while 'Paradana' balansa clover (*Trifolium balansae*) has been superior on some soils.

Both these cover crops mature seed slightly earlier, although they often do not produce as much biomass. Their big advantage over crimson clover is their ability to reseed for several years from a single seed crop. Both have volunteered back for three years following maturation of a seed crop in 1993 in Senatobia, MS, and they have also reseeded successfully for two years at Verona, MS, and Auburn, AL. In contrast, neither 'Tibbee' nor 'AU Robin' crimson clover reseeded for more than one year at any location.

Unlike crimson clover, whose flowers open at one time, spotted burclover produces clusters of three to five flowers on successive main stem nodes about 2.5 to 3 days apart. Individual seed weight increases steadily for 40 to 45 days after a flower opens and about 50 percent of seeds become viable and hard after about 30 days. This percentage increases to nearly 90 percent by 40 days.

Because insect feeding damages later flowers, more than half the seed produced on a typical burclover plant is formed in burs located on one of the first three flowering nodes. Thus, since most of the productive flowers open within the first 10 days of bloom, half of the maximum seed crop is formed by 40 days after first bloom and most of the rest by 50 days.

Farmers can use this information to determine when it is safe to kill their cover crop and still have a good expectation that it will reestablish itself the next fall.

At several locations in 1995, spotted burclover started blooming around March 20, 15 days earlier than 'Tibbee'. Field studies verified that burclover reseeding was successful 35 to 45 days after first bloom. Balansa clover bloomed about 10 days earlier than 'Tibbee'. Since both crimson and balansa clovers rapidly produce many flowers, they can reseed by 30 to 35 days after they first bloom.

Mowing was effective in killing rye and vetch cover crops during late April. Cover crop residues dry rapidly after mow-killing. Use of tined-wheel row cleaners enabled successful no-till cotton planting only two to six days after mow-killing dense cover crops.

By combining mow-killing, rowcleaners and reseeding spotted burclover or balansa clover cover crops, farmers can confidently plant cotton by the first week of May and not have to replant their cover crops after cotton harvest. These hard-seeded legumes reduce the need for purchased fertilizer N and facilitate crop rotations where the cover crops cannot make seed each year.

Heavy cover crop mulches did not eliminate the need for supplemental chemical and/or mechanical weed control. However, cover crops permitted no-till cotton to be produced using a banded herbicide application comparable to that used in conventional-tillage culture.

At David Denton's farm, postemergence herbicide requirements and soybean yields were similar where beans were no-till planted into mow-killed or spray-killed cover crops or where the cover crop was disked-in as green manure.

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Disease and Insect Management Using New Crop Rotations for Sustainable Production of Row Crops in the Southeastern United States

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Planting two crops in one year with minimum tillage in the southeastern U.S. during the past 20 years has often resulted in reduced crop rotation because a limited number of crops fit into the system. The wheat\soybean double cropping system was one of the most commonly used combinations. Continuous planting of this cropping sequence resulted in epidemics of take-all root rot of wheat, a disease previously unimportant in the region. New races of Hessian fly appeared that caused severe losses on susceptible wheat cultivars. Soybean stem canker also was epidemic.

Lack of profitability has caused the farmer-cooperator in the study to reduce soybean and corn production during the past five years and rely on shorter, more profitable rotations primarily with full-season wheat and peanuts. This project compares rotational sequences which incorporate additional new crops into the minimum tillage system with wheat and soybean to reduce pests on all crops through longer rotations.

Canola is an emerging crop which can be substituted for wheat or other small grains. A new cultivar of pearl millet is a potential summer rotational crop that can replace soybean in the minimum tillage system. This expanded system can increase the profitability of all crops and reduce pesticide use while maintaining soil and water quality.

Objectives

1.) To enhance double cropping systems with minimum tillage in the southeastern U.S. by expanding crop rotations which can be profitable and which can reduce diseases and insects.

2.) To incorporate improved cultivars of emerging crops canola and grain pearl millet into minimum tillage systems.

3.) To determine the optimal rotation system to manage diseases and insects in canola, pearl millet, soybeans and wheat.

4.) To demonstrate the usefulness of these rotations to growers on a commercial farm and at a major regional farm exposition site.

Approach

A series of 12 annual rotations with wheat, rye, or canola as the fall-planted crop followed by pearl millet or soybean as the summer crop was established at the University of Georgia Southwest Branch Experiment Station at Plains on a 3-acre site. Each rotation sequence was devised for a four-year period. Each sequence was planted in 1600 square foot plots and repeated four times.

Soil was infested with the fungus causing take-all root rot at the start of the study. Likewise, soybean stems infested with the stem canker fungus were distributed on the plot area to establish this pathogen. The effect of crop rotation on survival of these disease-causing fungi is being monitored. During the first year, take-all caused severe damage on wheat causing a yield reduction exceeding 70 percent. A decline in the population of the take-all fungus occurred in plots planted to canola and rye four months after planting. The decline of disease severity in tests on wheat seedlings grown in soil from canola plots was >70 percent compared with those grown in soil from wheat plots.

Results

Hessian fly populations in wheat were below economic thresholds. Aphids and false chinch bugs were present in canola, but were also well below damaging levels. Pearl millet rotations following canola, wheat and rye were examined. Seedling counts, number of heads, leaf diseases and yield were evaluated. Seedling establishment was slightly less successful and foliar necrosis and chlorosis were slightly less severe in pearl millet following canola than following small grains. There was no consistent effect of the previous crop on grain yield of pearl millet.

Damage to pearl millet seedlings from false chinch bugs was greater following canola than after wheat or rye. Populations of southern green stink bug were higher in heads of pearl millet after canola. Insect populations on soybean were not affected by the previous winter crop. Diseases on canola were very low and the first year rotations of winter crops had no effect on soybean stem canker disease.

This is the first comprehensive data on diseases and insect pests on wheat, canola, pearl millet and soybean in doublecrop rotations in the Southeast. These first year results provide a ref-

Project area

Integrated Management

Project duration

March 1994-Dec. 1997

Budget:

SARE	$152,200
ACE	
Matching	$52,614

erence for changes in disease and insect pests in subsequent years in the set of 12 rotations of all four crops.

By expanding the number of crops planted over time, we hope to take advantage of the decline of insect pests and disease organisms that typically occurs. The data collected will also provide insights into fluctuations of pest populations and the damage they cause in a variety of cropping sequences over a four year period. Optimum pest management systems for these combinations of crops have not been determined. The educational component of the project will demonstrate the usefulness of these rotations to growers on a commercial farm and at a major regional farm exposition site. Results will be communicated by written reports and video.

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Post-CRP Land Management and Sustainable Production Alternatives for Highly Erodible Lands in the Southern Great Plains

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As the bulk of CRP contracts will be expiring in 1996 and 1997, contract holders will have to choose a future use for their CRP lands. There is a general lack of integrated management guidelines on how these highly erodible lands should be used for grazing or how to revert to cropping while meeting conservation compliance. Many land-use and management options are available. Landowners or operators will choose whether to use CRP grasslands in livestock production or to revert to annual crop production. Decisions will include whether to remove the accumulated old litter or to plow or no till the first crop into the sod, or any other options for land use. Many management actions must be planned and taken well in advance of the day the contract expires.

Objectives

The objectives of this project are to identify best-management practices on how to prepare for grazing or haying CRP grasslands or to revert successfully and in an environmentally-sound manner to wheat and cotton production on highly-erodible lands in the Southern Plains. Researchers will evaluate the field performance and economics of the best options and transfer the information to the public and action agencies to help end-users determine their best course of action after the CRP.

Specific objectives are:

1.) Determine relative persistence of improvements to the soil resource base accumulated during the Conservation Reserve program under alternate land management practices.

2.) Identify best-management options and develop guidelines for environmentally sound cropping-livestock systems of production that will preserve and sustain the accumulated benefits to the soil resource base.

Approach

Under USDA-ARS coordination, a three-year collaborative project was conducted on two CRP fields under contract since 1987 and 1989 to develop sustainable post-contract options for CRP lands. Researchers, action agency personnel and local producers in NW and SW Oklahoma have been working together for the past year to identify and document Old World bluestem grass (OWB) management and conservation production practices for re-cropping CRP lands to wheat and cotton.

Field-scale experiments were conducted to compare a minimum-input practice and the optimal management of an OWB grass stand, conservation-tillage wheat (sweep or disk to kill the sod), no-tilling wheat into the OWB sod after herbicide applications, and, at the SW site, row-till cotton. Concurrently, small plot-scale studies were conducted to investigate the preservation of grass residues, herbicide and tillage combinations that will kill the sod and fertilizer needs of a winter wheat crop growing under such conditions.

Active involvement of the state and federal action agency field offices in conducting the field research, and local agro-businesses and producers in carrying out selected field operations were actively sought to facilitate the technology transfer by diffusion during such interactions. Other outreach efforts were made to prepare publications and news articles for the local and regional press. Field days were conducted at each location to inform the public and elaborate on the research and management options.

Data was collected on grass and crop growth and final yields, weather conditions, soil characteristics, and water status during the growing season and non-cropped periods to calculate water use and storage-efficiency of the various production options. Estimates of soil physical and biochemical property changes and erosion will be made to document the relative persistence of benefits accrued under the CRP. A journal of field supplies, operations, equipment, and time was kept to derive an economic analysis of each land use option.

Results

The 1994 data showed that CRP lands planted to Old World bluestem required many improvements before they could be used in hay or grazing livestock production. Greatest limitations were inadequate N, P, stand and forage quality. The large accumulation of old dry matter lowered the quality of the hay. Management actions are needed on CRP fields at the end of the contract to convert these grasslands into productive lands. Plant nutrient amendments and weed control must

Project area

Management system

Project duration

March 1994-Dec. 1997

Budget:

SARE	$196,100
ACE	
Matching	$90,000

be made to optimize production and improve density and quality of the stand. It was found that interactions between soils and climate (that is, rainfall amount and distribution) strongly influenced plant response to applied fertilizers. For example, a small-to-none increase in production occurred in the 18-inch precipitation zone as compared to a 2.9-fold increase in production in the 29-inch precipitation zone.

The timing of suppression of a hardy warm-season grass cover is critical for conserving stored water. This is vital to the success of producing winter wheat in the year a CRP contract expires, otherwise producers will lose a full year of production. Unsuppressed growth of the warm-season grass during the spring depleted the soil profile of moisture; therefore, early tillage or chemical suppression of the OWB sod must occur in April or May. Producers must be allowed to work to suppress the sod much earlier than the 90- to 120-day period before the expiration date of a CRP contract.

The amount of dry matter removed is critical to how well we can perform conservation- and no-tillage, kill a hardy warm-season sod and establish a good plant stand. Without prior removal of the old growth, application of 0.75 to 1 lb ai/A glyphosate suppressed OWB in the NW while rates up to 1.5 lb/A did not at the SW site. However, a spring and fall sequential applications of 1.0 lb/A of glyphosate to the regrowing grass gave better than 90 percent control of OWB, uniform stands and growth of the wheat crop with prior removal of the old growth.

In nutrient-depleted CRP lands, N and P fertilizers must be applied to convert these HEL into productive wheat lands, regardless of tillage or no-tillage methods. Wheat response to fertilizer was either a three-fold or a 1.6-fold increase, depending on whether we were in the 18- or 29-in rainfall zone. Crop yields were 75 percent higher at the SW site than the NW.

In conclusion, the results showed the need to move back the time line that CRP landowners or operators would be permitted to work on the grass cover, if provisions for soil erosion control are in place. Early spring suppression of the grass will conserve stored water that is vital to the production of a cool-season crop in the Great Plains and save a year of production. The results also showed that management actions are needed now. Landowners or operators should be advised of the risks of the neglected conditions and nutrient depletion that currently exist on CRP lands.

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Animal Waste, Winter Cover Crops and Biological Antagonists for Sustained Management of Columbia Lance and Other Nematodes on Cotton

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Plant-parasitic nematodes are a major constraint to cotton and other crop production in the southern United States. These parasites limit root development, resulting in a general stunting of the plant. Restricted root development prevents the plant from adequately exploiting the soil for mineral nutrition and moisture. In addition to losses in cotton yield, the inability of the plant to remove nutrients and moisture from the soil can result in these nutrients and/or pesticides moving into ground or surface waters and thus becoming pollutants.

Animal-waste products also are of major concern as sources of water pollution. Because of their high nutrient content, however, they can be substituted for chemical fertilizers in many instances. The use of manures rather than chemical fertilizers is an environmentally sound method of supplying necessary nutrients to the plant while disposing of this waste product. These waste products would become pollutants if not properly managed. The high nitrogen content of these materials make them ideal candidates for managing populations of parasitic nematodes in soil. Ammonia and urea are toxic to nematodes, but very high rates may also be toxic to crop plants. The ammonia in animal wastes such as poultry litter are like slow release fertilizers and can thus inhibit nematodes while supplying the plant with nitrogen in a safe manner. Another benefit of organic fertilizers is that they increase beneficial microbial activity (including favorable parasitic nematodes) in soils which may aid in achieving a healthier, better balanced soil environment.

Addition of animal waste products to the soil and plowing under winter cover crops which are commonly grown to prevent soil erosion is generally beneficial because they increase the organic matter content of the soil. This is especially important in southern soils since they tend to be low in organic matter when cultivated. Increasing the level of organic material in these soils improves their nutrient and moisture retention properties which favors the plant. A winter rye crop in particular is beneficial in that it suppresses many parasitic nematodes. Enhanced microbial activity as a result of the application of animal waste products and/or winter cover crops can provide for an environment where antagonists of plant-parasitic nematodes, especially certain fungi, can aid in managing these pests. The use of poultry litter to manage nematode pests of cotton and promote soil health provides a method of biorational pest control that can also reduce the rates of application of chemical pesticides and fertilizers while converting a waste product into a useful material.

The proper selection and management of winter cover crops can enhance pest management programs, scavenge surplus nutrients that would otherwise move into ground and surface waters; improve soil health, tilth, soil moisture retention in porous soils, and also serve their primary purpose of preventing erosion of topsoils. All of the aforementioned factors serve to enhance sustainability of agricultural production by providing for an improved agroecosystem. Potential reductions in costly inputs used by farmers can reduce their reliance on petroleum-based products for pest control and/or chemical fertilizer. Reduced reliance on these products also serves to protect water and air quality.

Objectives

1.) Evaluate the effects of the rate of poultry manure and litter and municipal-waste compost singly and in combination with winter-cover crops and selected nematode antagonists for control of plant parasitic nematodes on cotton.

2.) Determine the potential advantages of organic sources of nitrogen versus standard fertilizers on nitrogen use efficiency and potential environmental impacts.

3.) Incorporate findings into a sustainable cotton- and associated crop-production systems through a series of farmer-managed demonstration tests, tours, cotton production meetings and extension publications.

Approach

A combination of greenhouse, microplot and field research plots were used to evaluate a winter rye cover crop with or without poultry litter and fungi for management of root-knot, sting, Columbia lance, stubby-root and reniform nematodes in cotton. All experiments were replicated to permit statistical analysis of the results. Five field

Project area

Biological pest control

Project duration

March.1994-Dec.1997

Budget:

SARE	$ 143,412
ACE	
Matching	$36,949

research experiments, four in growers' fields and one on an experiment station, were utilized as field laboratories. The field plots also served an educational function in that they were featured in research tours used to inform farmers about this work. Greenhouse and small plot tests were conducted in order to more precisely quantify the effects of selected nematode antagonists on these biological systems. This information has been and will continue to be disseminated to Extension personnel, farmers and the general public. Measurements included cotton yield and numbers of parasitic and nonparasitic nematodes, as affected by poultry litter and or a rye cover crop.

Results

Preliminary greenhouse and field experiments have demonstrated the benefits of application of poultry litter for management of plant-parasitic nematodes in cotton and for enhanced cotton productivity in coastal plain soils. The inclusion of fungi that parasitize these nematodes was also beneficial in greenhouse tests, but not at a statistically significant level. A rye cover crop was effective in suppressing Columbia lance nematode in field experiments, as well as root-knot, reniform and stubby root nematodes in greenhouse tests.

The use of poultry litter to manage nematode pests of cotton and promote soil health provides a method of biorational pest control that can also reduce the rates of application of chemical pesticides and fertilizers while converting a waste product into a useful material. In contrast, heavy applications of commercial fertilizers increased levels of plant-parasitic nematodes. Thus, the proper selection and management of winter cover crops and animal waste can enhance pest management programs, scavenge surplus nutrients that would otherwise move into ground and surface waters, improve soil health, tilth, improve soil moisture retention in porous soils, and also serve the primary purpose of preventing erosion of top soils.

All of the aforementioned factors serve to enhance sustainability of agricultural production by providing for a better and healthier agroecosystem. Potential reductions in costly inputs used by farmers can reduce their reliance on petroleum based products for pest control and or energy intensive fertilizer products. Reduced reliance on these products also serves to protect water and air quality, thus improving the environment. Coastal plain soils of this area are by definition porous, highly leached and tend to be low in organic matter when cultivated. Addition of organic amendments to these soils, whether supplied as animal manure or produced in situ as in the case of a winter cover crop, can be used to improve soil health, soil tilth and water holding capacity which are major constraints in agricultural productivity.

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Integrating Sustainable Forestry into the Whole Farm Management of Minority and Limited Resource Landowners in Two Regions of Arkansas

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The project is comparing community-based participatory strategies to encourage limited resource and minority farmers to integrate sustainable woodland management into their whole farm system. Woodlands (predominantly hardwoods) are a potentially important source of farm income for landowners in the Delta and the Ozark Foothills regions of Arkansas. In these areas limited resource and minority farmers historically do not participate in traditional outreach programs such as management planning by the Arkansas Forestry Commission, training by Cooperative Extension, the Conservation Reserve Program and the Wetlands Reserve Program.

These farmer-owned woodlands, typically areas marginal for farming (wet areas or steep slopes), are treated as "savings accounts" with the only "management" being a "high-grade" harvest when the owner needs extra cash. Due to low volume, low quality and lack of knowledge as to true values the owners often receive only a small portion of the true economic value of the woodlands when they do sell timber.

Objectives

1.) Test context-appropriate participatory strategies to promote sustainable farm forestry for the Delta and Ozarks.

2.) Compare context and strategies to identify factors that influence effectiveness.

3.) Engage limited resource and minority farmers, community based organizations, technical advisors and policy makers in a dialogue about how best to effectively promote sustainable management of hardwoods on the farm.

4.) Evaluate existing policies and programs.

Approach

The project partners are implementing context-specific strategies to integrate sustainable woodland management into whole farm management. Farmer participation is a critical element and is being obtained through land owner associations and community-based organizations. Project partners and participating farmers will evaluate and recommend state and federal programs and policies to encourage sustainable woodland management. This evaluation is, in part, being provided through Winrock's affiliation with the LMDDC, BCSD and the committee for Reforestation to Achieve Sustainable Development (RASD). Project direction is provided by a steering committee composed of representatives of all organizational and farmer participants.

Participants are collaborating in the collection and development of fact sheets on sustainable farm forestry which are designed to reach educationally disadvantaged farmers. These fact sheets are being assembled into localized handbooks targeted to the unique needs of the two project areas.

At the farm level, ALFDC has been active in a seven-county area in the Delta and has:

*Developed and are in the process of implementing a management plan for a 118 acre woodland area to serve as a demonstration of sustainable woodland management. The area will serve as a training site and demonstration for the 700 plus members of ALFDC.

*Utilized workshops and farm visits to train a number of individuals in sustainable forestry and whole farm management.

*Assisted and empowered farmer members to establish farmer to farmer woodland management networks.

*Incorporated training in sustainable woodland management into the Youth Enterprise in Agriculture (YEA) program.

*Through the YEA program has assisted landless youth in gaining information which could lead to the establishment of woodland-based small scale non-timber enterprises as part of their supervised work experience (e.g., botanicals, mushroom production).

*Coordinated with wildlife management specialists to incorporate wildlife restoration into management plans and provide training in same to farmers.

ALFDC will provide training sessions to secure the following outcomes for farmers and youth participant:

1.) Information about timber and nontimber values and options for marketing woodland products and services

2.) Knowledge and access to resources to develop woodland management plans

3.) Demonstration of appropriate agroforestry

Project area
Integrated systems

Project duration
April 1994-Dec. 1997

Budget:

SARE	$246,710
ACE	
Matching	$159,086

practices that integrate sustainable forestry practices with alternative crop and livestock production.

4.) Use of ALFDC's 280-acre site to practice basic woodland management skills.

In the Ozark Foothills RC&D area, assistance has been provided to:

1.) Help farmers with woodlands organize county associations.

2.) Train farmer/leaders to provide conceptual and technical leadership to these associations.

3.) Develop training sessions for association members.

4.) Develop an association newsletter.

5.) Develop three on-farm sustainable hardwood demonstrations.

6.) Organize field days and assemble fact sheets and other materials to disseminate knowledge generated from the demonstrations.

7.) Nurture linkages between the emerging associations and technical advisors from state and federal agencies.

8.) Assist farmers in integrating livestock and woodland management.

9.) Assist farmers in identifying and developing non-timber values (e.g., botanicals, hunting leases)

In support of the above enumerated on-farm efforts, Winrock will provide an economic analysis of the outcomes and recommendations at the farm level. Winrock will also provide, as needed, highly specialized consultants and assist in preparation of fact sheets. The Nature Conservancy will provide technical staff to assist in evaluation of environmental values and explore the environmental consequences of timber and nontimber enterprise development. TNC will also provide a market analysis for botanicals and provide technical and editorial support for fact sheets.

At the policy level Winrock and TNC continue to review literature on how limited resource and minority farmers make decisions about woodland management and sustainable agriculture. Meetings have been planned for the first quarter of 1996 to secure input from limited resource/minority farmers and elected and agency policy makers on the effectiveness of current programs and policies as relates to sustainable woodland management in the whole farm operation.

Results

In the Ozark Foothills, this project has developed a Woodland Landowners Association in Independence County to assist with management and marketing activities. The association has more than 150 members. Four field days have been held to provide training and demonstrations in forest management techniques. More than 150 individuals attended the initial field day. The association is publishing a quarterly newsletter providing market information, timber prices and management tips.

Active participation in association organization and field day activities has been obtained from the Natural Resources Conservation Service, the Cooperative Extension Service and the Arkansas Forestry Commission. Efforts are in progress to establish a second woodland owners association in Izard County.

In the Delta the Arkansas Land and Farm Development Corporation has completed a woodland management plan for a 119-acre forest on their property. This woodland will be used as a demonstration and training site. A green house has been constructed and is being used to demonstrate the production of Shiitake mushrooms as an alternative, woodland-based non-timber enterprise.

Through planned training sessions and site visits by area farmers considerable information has been provided by ALFDC on these activities. Winrock, TNC and RC&D have collected appropriate literature (research reports, fact sheets, videos, etc.) from numerous sources. Review of the material is complete with an annotated bibliography prepared for specific material applicable to this project area and Arkansas. We are currently in the process of "user" review to select material most likely to be used by limited resource/minority landowners and to identify informational gaps for which new material needs to be developed.

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Intercropping Small Grains and Lupin for Sustainable On-Farm Utilization

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Project area
Cropping systems

Project duration
March 1994-Dec. 1997

Budget:
SARE $143,151
ACE
Matching $164,759

This project is concerned with developing alternative sources of high-quality feed for the dairy farmers of the Southeast. The researchers are developing and testing binary mixtures of lupin, a new kind of grain legume and small grains, such as wheat and oat. First-year results from both on-farm and research station experiments indicate that 25 tons/acre of 65 percent moisture silage of excellent quality can be produced during a six-month growing season.

Intercropping, growing two crops on the same land at the same time, is an age old practice that has all but disappeared from modern American agriculture. It is still widely practiced in the tropics where yield stability and diversity is more important than maximum yield per unit area. Other advantages are a reduction in disease incidence and insect pests. Plant viruses, transmitted by insects, are also often less serious in mixed stands compared to pure stands.

Dairy farmers in the southeastern United States are at a disadvantage compared to their colleagues in other parts of the country. They have to work harder to generate the base feed for their dairy herd. Alfalfa and corn silage are the basic staples of dairying in most of the country. Because of the large management input required it is not very economical to grow alfalfa in the Southeast. Yields for corn silage are also lower than in other parts of the country. The South, however, has one advantage over most other regions. It has a virtually 12-month growing season with the ability to grow cool season crops during the fall-winter-spring season. Traditional winter crops have been small grains for grain, grazing or silage.

Silage is often the desired form to feed forages to dairy cattle because (1) field losses are less, (2) harvesting is not affected as much by weather as is haying, (3) silage involves less labor in feeding on most farms, (4) silage is much easier than hay to use in "total mixed rations", a method used on the majority of today's dairies, and (5) ensiling crops often blend into double cropping more readily than other methods of harvesting.

Therefore, use of silage helps the Southeastern dairy producer in managing feed quality, land/crop management, ease of feeding and, if used properly, profitability/sustainability. Wheat silage is considered a very good winter crop for the Southeast, but does not possess some of the feeding or agronomic advantages of legumes.

Four on-farm and research station experiments were conducted to develop and test binary mixtures of small grain and lupin. White lupin is a winter grown annual legume adapted to well-drained, low-fertility, coarse-textured, neutral to acidic soils, such as those in the Southern Coastal Plain. Lupin possess some of the advantages mentioned in the previous paragraph, but information on lupin silage is limited. Based upon data available, lupin silage is palatable if harvested at the proper maturity, although energy content may be relatively low due to fibrous parts of the plants, such as stalks. Binary mixtures of wheat and lupin may provide the advantage of yield increases, as well as maintaining a smaller stalk of lupin and therefore, reducing fiber content of the lupin. In addition, wheat-lupin mixtures could allow the wilting of the crop to improve ensiling properties without a major loss of leaf, which occurs when lupin alone is wilted. Therefore, silage binary mixtures could have several advantages over either crop alone.

Objectives

The objective of the research station experiment is to establish a practical range of seeding rates and small grain to lupin ratios. To accomplish this, one wheat and two lupin cultivars at six seeding rates in pure stands were established. Three wheat seeding rates were then tested in mixture with four seeding rates for each of two distinct lupin cultivars for a total of 24 intercropped stands. Researchers harvested a portion of each plot six times, beginning at flowering. They measured yield and forage quality characteristics at each harvest date. Maximum biomass was achieved at full bloom for lupin. This is good news because quality declines with advancing maturity.

On the average, this trial yielded 25 tons of silage (65 percent moisture) per acre in a six months growing season. It is emphasized, however, that these are results from only a single year and a single location. More research is needed.

Approach

Two on-farm trials tested a smaller range of small grain lupin combinations under actual production conditions. Regular farm implements were used to prepare the field and put the seed

into the ground. For a yield estimate, a small area from each plot was harvested with a 3-foot sickle bar mower. On-farm trial results emphasize the impact of nature on agricultural experiments. Participants weren't able to plant at the ideal time in Virginia because it was too dry. Late planting and competition from chickweed, a common winter weed in the South, resulted in a very poor stand. A severe rust epidemic at the Alabama location reduced oat yields substantially, compared to expected yields. Nevertheless, the average silage yield (65 percent moisture) at the Alabama location was 11 tons per acre. Given the problems that the crop encountered, it was still considered a respectable showing.

The third on-farm trial was a demonstration of the usefulness of white lupin as a winter cover or green manure crop. The location was the Black Marsh Farm in Virginia's Rappahannock River Valley. A 12-acre field was seeded to white lupin in October 1994. In late spring, technicians measured dry matter yield and calculated nitrogen concentration. Lupin contributed about 110 lbs of nitrogen per acre to the crop following it, sweetcorn.

High quality silage can be produced during the fall and winter to be used in base rations on dairy farms. These first-year results are very encouraging but also show the need for continued research on experiment stations and on farms.

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Regional Center for Sustainable Dairy Farming

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Cooperators continued on next page

Project area
Integrated systems

Project duration
March 1994-Dec. 1997

Budget:
SARE $180,497
ACE
Matching $127,924

Objectives

Objectives included a comprehensive comparison of two systems of dairy production and appropriate dissemination of results to the dairy industry. One production system was based on use of intensively managed pasture crops in contrast to a system using row crops, harvested forage and conventional confinement housing and feeding. Because of growing concerns about environmental issues, comparisons between the two production systems include impacts on nutrient cycles, water quality and soil conservation as well as animal health, reproduction, productivity and profitability of the dairy production systems. In addition we are investigating the feasibility of seasonal milk production (spring or fall calving) within the two systems.

Approach

The primary location of the project is at NCSU's Dairy Educational Unit in Raleigh, North Carolina but demonstration sites include the dairy at North Carolina A&T State University and at several cooperating dairy farms in North Carolina, South Carolina and Virginia.

During 1994 and early 1995, about 77 acres of cropland adjacent to NCSU dairy was surveyed, divided into 38 paddocks with lanes, fencing and water lines installed. Paddocks were seeded to various pasture species including 12.6 acres of alfalfa, 46.2 acres of grass-legume mixtures, 7.1 acres of caucasian bluestem grass and 11.1 acres of hybrid Bermuda grass. These species allow for growth of pastures in both cool and warm seasons. Both caucasion bluestem and Bermuda grass can be overseeded with winter annuals to provide additional grazing in winter. A similar program has been designed for the grazing demonstration at NCA&T. Much of the seeding is completed there with fencing, lanes and water lines nearing completion.

In March 1995, 48 Holsteins and 24 Jerseys were divided equally between the pasture and confinement treatments for the first replicate of the study. Because the grazing system was new to all the workers at the dairy, the first year's experience involved much learning and adjustments to be sure cows were allocated the proper amount of pasture each day. Also, researchers varied the amount of grain feeding in an attempt to determine optimal amounts and that may have affected body condition, production and reproduction in the grazing group. In contrast, the confinement cows were fed a reasonably consistent total ration (grain blended with corn silage and alfalfa haylage).

Results

There were marked differences in the levels of milk production and in daily feed costs with the two systems. The confinement herd produced more milk per cow per day through the lactation but feed costs were also higher for confinement cows. In percentages, grazing Holsteins produced 16.5 percent less milk and grazing Jerseys produced 12.8 percent less than their counterparts in confinement. This extra milk was worth $1.36 per cow per day but cost $1.32 per cow per day in extra feed costs. Therefore, income over feed cost was virtually identical between the two groups. Both groups had lower reproduction success than desired with 52 percent of the pasture group pregnant in a 75 day breeding season compared to 72 percent of the confinement groups.

Some of this could be attributed to lower body condition scores and some to poor heat detection late in the breeding season for pasture cows kept farther from the barn. Mastitis tended to be higher for confinement cows but several pasture cows (Holsteins) had sore feet from walking on gravel in lanes and one cow died from bloat when grazing alfalfa.

These results are preliminary and a fall calving replicate is now underway. With more experience in managing the grazing system, economic advantages may become apparent. Even if income over feed costs is similar, environmental factors may give an advantage to grazing because of less potential for erosion, nutrient runoff and less need to store and handle manure and waste water.

Outreach activities in the last year have included participation in and support of a Mid-Atlantic dairy grazing field day on July 11 and 12 in Virginia, hosting a field day on November 1 at NCSU and development of a proposal that was funded in the North Carolina legislature to convert a North Carolina Department of Agriculture herd into a grazing-based dairy at the Center for Environmental Farming Systems in Goldsboro.

Advisory meetings for the *Regional Center for Sustainable Dairy Farming* were held in May, 1994 and in March, 1995.

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Wildlife Enhancement and Education as a Catalyst in the Widespread Implementation of Sustainable Agricultural Practices

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Alligator River National Wildlife Refuge

Murphy Family Farms

Goldsboro Milling Company

North Carolina Wildlife Federation

Project area
Integrated management

Project duration
March 1995-Dec.1998

Budget:

SARE	$98, 205
ACE	$75, 000
Matching	$202, 904

When sustainable agricultural practices are adopted by producers, wildlife and other environmental benefits accrue across the farm landscape. Research and demonstration work conducted in a previous SARE/ACE-supported project conclusively demonstrated that desirable wildlife populations increase in response to field borders adjacent to drainage ditches. The proposed project will create a network of farmers, farm organizations, agency professionals, wildlife advocates and educators that will focus upon wildlife and agricultural issues.

Twenty-four growers working with scientists in four distinct agronomic regions will establish field border systems and evaluate their wildlife, water quality and economic impacts. On two government-owned farms, controlled experiments will provide high resolution data on water quality parameters influenced by alternative field border vegetation. A salient outcome will be a proven field border adoption package for producers, landowners and natural resource professionals, that includes a spreadsheet detailing costs and benefits of implementation options. A truly unique component of the proposed work will be direct participation in the project by *Carolina Outdoor Journal*, a public television program focused upon environmental education of farmers and outdoor enthusiasts.

Objectives

1.) Utilize regional focus groups to establish a mutually-supporting network of farmers, natural resource managers, agricultural professionals, environmental leaders and educators dedicated to enhancing wildlife via the adoption of sustainable agricultural systems.

2.) Implement producer-designed, field border management systems that enhance wildlife and water quality on a minimum of 26 farms adapted to four distinct agronomic regions in North Carolina.

3.) Measure the response of wildlife populations and water quality to the implemented field border systems.

4.) Evaluate the economic and social feasibility of incorporating sustainable agricultural practices on eastern North Carolina farms.

5.) Inform and educate producers, the rural community and the public on the ecological and economic benefits of sustainable agriculture via public television and other media

6.) Produce an educational "package", for growers, landowners, and natural resource managers, including video, computer software, and printed material, to encourage widespread, rapid adoption of sustainable practices.

Approach

This issue-oriented research, demonstration and education project goes beyond narrowly focused natural resource/agronomic research to unite agronomic, economic, social, and natural resource interests. Our previous SARE/ACE research and review bulletin (Palmer and Bromley, 1992) helped resolve the issue of pesticide impacts on wildlife. It showed that, with few exceptions, quail were not directly harmed by modern pesticides. While this major finding will relieve concerned farmers and environmentalists, there is convincing evidence that indirect effects of pesticides, as currently used in farming systems, limit wildlife numbers on farms. We have demonstrated that field borders established to protect water quality can offset indirect pesticide impacts. Although the farming community is aware of our recently completed work, localized demonstration of field borders is essential before farmers will adopt these practices.

Focus group meetings in four distinct agronomic regions in North Carolina will serve to identify farmers willing to implement innovations in field management (Objective 1 and 2). Our previous work showed the focus group to be an extremely effective method of enlisting farmer support of sustainable agricultural research and demonstration efforts. Participating farmers will be directly involved in developing and designing field border tests that fit their unique operations. Emphasis will be placed upon maintenance of field borders consisting of native, herbaceous vegetation. In addition to the privately owned farms, we will conduct highly controlled research on 3,400 intensely farmed acres at Alligator River National Wildlife Refuge. Our second highly controlled farm will be at the 2,300 acre North Carolina Center for

Environmental Farming Systems at Goldsboro.

Four distinct farm types are determined by North Carolina's geographical regions. Grain farms, tobacco farms, peanut farms and cattle farms predominate in the tidewater, lower coastal plain, upper coastal plain and piedmont regions, respectively. Six farm cooperators per region, volunteering a minimum of 500 acres each, will be identified. An additional six farms will be monitored as controls, preferably operated by the same farmer but separated by space.

To measure response of wildlife populations and water quality to field border implementation (Objective 3), on the test farms, we will follow the adaptive resource management paradigm of Walters (1986) to test biological and environmental responses. Wildlife populations will be measured one year prior to, and two years following, establishment of sustainable packages. Direct measurements of wildlife population response will include spring songbird and quail singing indices, quail and rabbit sighting counts, and fall/winter covey call counts and trained dog searches (Stauffer, 1993). Fall/Winter quail covey counts using trained dogs will be completed with the cooperation of local Quail Unlimited members.

Indirect measurements of wildlife benefit will include habitat variables critical to bobwhite quail, cottontail rabbit, and songbirds. Additionally, quail chick insect-feeding rates, a critical limiting factor on modern farms (Potts 1986), will be compared in treatment and control fields using a successful imprinting approach developed in our previous SARE/ACE project (Palmer et al. 1994). Cooperating growers implementing field border systems will also be advised as to how they might use more sustainable cultural practices in their various commodity enterprises.

Water quality benefits derived from field borders will be determined at selected sites on cooperating farms. Nitrate, phosphate and sediment movement across field borders will be measured. Where animal wastes are used, relative field border efficiencies will be estimated by measuring biological oxygen demand (BOD; Mikkelsen and Gilliam, 1994). There will be two levels of intensity in water quality measurements. On Alligator River National Wildlife Refuge and on the Center for Environmental Farming Systems we will establish 12-foot wide field borders of native vegetation, and fescue, and a control without a vegetative strip on four ditches at each location.

In combination with water flow measurements in these ditches, we will measure nutrient and sediment loads immediately after major rainfall events. With the groups of cooperating farmers, the producers will select field border planting materials from plant varieties eligible for cost-share from the North Carolina Division of Soil and Water Conservation and/or the Natural Resource Conservation Service. The control groups within each of these four test regions will continue their current, clean farming practices. On all farms, we will regularly take instantaneous or grab samples of water in drainage ditches to measure water quality after tillage, soil conditioning, and planting, following crop establishment, and post-harvest.

To evaluate the economic and social feasibility of incorporating sustainable agricultural practices (Objective 4), the project team will measure the full costs and benefits associated with field border establishment on cooperating farms, including loss of crop yields, reduction in expenditures for seed, fertilizer and pesticides, and maintenance costs of field borders.

Incremental cost and benefit analyses of the field border systems implemented by cooperating producers will include, for example, the willingness of sportsmen to pay for increased access to improved wild quail hunting. Avid quail hunters who are cooperators with the North Carolina Wildlife Resources Commission and/or members of the North Carolina Chapter of Quail Unlimited will be surveyed to determine their current investment in quail hunting by use of the travel cost model and their demand for better quail hunting through the contingent valuation model. Microeconomic studies will evaluate various policy alternatives that include voluntary, paid or a combination of voluntary and paid diversion of crop land into field borders and sustainable wildlife habitat. The willingness of producers to incorporate field borders into their farming systems will be evaluated at focus group meetings with cooperating farmers when the project starts and when it ends. Such factors as economic costs and benefits, appreciation for ecological benefits, desire to increase farm income through leasing hunting rights, and aesthetic concerns about the appearance of the farm will be probed at focus group meetings.

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Pasture-Based Swine Production Systems for Limited-Resource Farms in the Mississippi Delta

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Arkansas Soil Conservation
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This demonstration-education project will provide technical assistance to aid limited-resource farmers in adopting a pasture-based swine production system. The design requirements entail low-capital inputs adaptable to farming situations that exist on small-scale farms located in the Mississippi Delta region.

Objectives:

1.) Evaluate various designs for pasture-based pig production and selection of design(s) adaptable to the Mississippi Delta region.

2.) Develop an effective training system to increase the number of limited-resource farmers with technical knowledge of pasture-based pig production.

3.) Provide training and technical assistance to limited-resource farmers to increase the adoption rate of pasture-based pig production in the Mississippi Delta region

4.) Assess the economic and social impact of pasture-based pig production in the Mississippi Delta region.

Approach

The first year of this three-year project will focus on social marketing and promoting awareness and interest for pasture-based pig production, system design, evaluation and selection. The second and third years will expand outreach through training, demonstration and dissemination activities.

A project advisory committee will consist of farmers and representatives of participating agencies. The committee's function will be to outline a timeline for the project; to plan and schedule training events; to meet periodically to assess the progress of the project; to make decisions that will adjust project activities based on intended or unintended developments; and to oversee all project operations.

A major focus of the project will be the establishment of a community-based training and demonstration structure for pasture-based pig production. The demonstration sites will include the ALFDC's 266-acre crop, pasture, woodland, and wetland demonstration farm in Fargo, AR, and two privately-owned farms operated by Ben Anthony and Herman Gilmore 40 miles away in Marianna, AR. Mr. Anthony's farm is a 150-acre diversified operation consisting of truck crops, soybeans, beef cattle, poultry, and a 12-sow semi-confinement operation. Mr. Gilmore operates a mixed farm that includes row crops, truck crops, and a 16-sow semi-confinement operation.

The design or designs selected will be ecologically-sound and emphasize the intensive management of the swine in their total environment. The design(s) used will be suitable for a particular situation and acceptable to the farmer. To reduce labor, a British design will be considered (Thornton, 1990). This system involves subdividing pastures into paddocks in a manner that resembles a wagon wheel. The paddocks radiate in a pie-shaped wedge pattern from the central working area or "hub" to the perimeter fence.

Appropriate housing for each phase (gestation, farrowing, etc.) of production and for the boars will be designed to be durable, transportable and provide pigs with protection from inclement weather. More than one farrowing-hut design will be used to assess producer preference based on convenience and fabrication. Plans will be available for each design.

To help lower sow and boar feed costs, attempts will be made to provide year-round forage of good quality that will also provide erosion control and soil fertility. A three-year study in Alabama showed significant feed cost savings from pasture grazing which accounted for two-thirds of a sow's ration (Anonymous, 1987). To prevent excessive treading and rooting of the pasture, and to maintain forage quality, hogs will be rotated among paddocks. It is anticipated that several combinations of traditional and/or non-traditional forage crops will be used to determine suitable and effective combinations. Other methods to lower feed costs include feeding by-product feeds, allowing hogs to self-harvest ("hogging off") crops, and allowing hogs to glean crops following harvest. Rice bran, a by-product of rice milling, can be utilized by swine, especially sows, (Farrell and Hutton, 1990) and is readily available in the Mississippi Delta region.

Approach to reach Objective 1:

1.) Feedback from cooperating farmers and other farmers producing hogs outdoors will help identify production constraints associated with pasture-based pig production. Farmers will be

Project area
Integrated systems

Project duration
March 1995-Dec. 1998

Budget:

SARE	$274, 412
ACE	
Matching	$68,852

instrumental in selecting a pasture-based system suitable for their farm. Criteria will include the type of operation (farrow-to-finish, feeder pig, etc.), location of markets, forage systems, and the potential for future expansion. Research, popular press, and ATTRA (Appropriate Technology Transfer for Rural Areas) publications, personal communications, and visiting pasture-based pig operations, are additional tools that will be used to facilitate the processes of system selection and implementation.

2.) The Natural Resource Conservation Service will provide technical assistance and training on the farms for selecting the sites for pasture-based system. Criteria may include soil permeability, manure utilization and composting methods, erosion factors, and etc.

3.) The ASU will assist the farmers with finding and selecting suitable breeding stock, with the identification of alternative feeds and formulation of least-cost rations, with forage-production techniques, with preparing a herd-health calendar, with identifying and utilizing existing structures and resources, and with profit projection analyses.

Approach to reach Objective 2:

1.) Communication channels will be established between farmers, the ASU management team and the farm management staff at ALFDC. This will facilitate feedback dialogue identifying specific production constraints and training needs for implementing pasture-based pig production. This will consist of routinely scheduled farm visits by the team, technical exchange discussions, and hands-on farm demonstrations. The farmers and project team will develop a management strategy during each visit to be practiced between visits and evaluated during the next visit.

2.) Mr. Anthony and Mr. Gilmore will serve as paraprofessional farmer/trainers or model farmers. They will be assigned to a network of targeted farmers whom they will train as they were trained. ALFDC will coordinate the training. Targets will include entry-level and experienced farmers recruited by ALFDC. Farmer trainers will be asked to demonstrate their knowledge and skills in pasture-based pig production practices to target farmers. This is expected to stimulate informal discussion among farmers and ASU management team. These sessions will be video taped.

Approach to reach Objective 3:

1.) Field days at institutional and private farms will be videotaped.

2.) Workshops will be conducted on pasture-based pig production and presentations will be made by paraprofessional and targeted farmers. Farmers and youth will identify with farmers from their community who are successfully operating pork enterprises.

3.) Fact sheets and a handbook on pasture-based pig production will be developed through a committee composed of ALFDC, ASU, NRCS, CES and paraprofessional farmer trainers.

4.) Each workshop will be evaluated by participants for interest and effectiveness.

5.) ALFDC and other service-providers will supply timely financing and technical assistance to limited-resource farmers.

Approach to reach Objective 4:

1.) ALFDC and ASU will design a user-friendly, manual record-keeping system for pasture-based pig production to track capital and operating costs, animal performance, and herd health. Over the life of the project, training will be developed to promote the use of a computerized record-keeping system.

2.) Economic and animal performance (farrowing rates, gain, conception rates, etc.) data of a pasture-based system will be compared with that of a total-confinement system located on the ASU farm.

3.) The AEC will conduct marketing research to test demand elasticity and market segment share for pasture-based or free-range pork as a specialty livestock enterprise. AEC has a mission to promote and support marketing opportunities for limited-resource farm families in Arkansas.

4.) Conducting social and economic surveys, questionnaires and focus interviews over the life of the project with paraprofessional-farmer trainers and targeted farmers will heighten understanding about alternative livestock systems as a component of whole farm income streams. These approaches will identify and provide analysis on which of the limited-resource farmers are receptive to adopting pasture-based pig enterprise systems. Moreover, the approaches will expand social impact assessment to the technical, economic and social requirements needed for successful adoption.

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Using Farm Family Case Studies to Teach Sustainable Agriculture

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Project area
Integrated systems

Project duration
March 1995-Dec. 1997

Budget:
SARE $146, 630
ACE
Matching $137,090

Many techniques have been developed to improve the sustainability of agricultural production. The challenge faced now is achieving widespread support and adoption of these practices by producers. The Southern Region has a rich tradition in conducting on-farm demonstrations and educational projects, and many of these are now focused on sustainable agriculture.

The purpose of this project is to extend the results and experiences obtained in on-farm projects in Kentucky, Tennessee, and Mississippi to farm and non-farm audiences. A high-quality videotape will be developed based on whole-farm case studies of commercial and limited resource farms that employ sustainable agriculture practices. Abbreviated versions of this videotape will be prepared for youth, policy makers and non-farm audiences, and for use as public service announcements. Farm families will be featured in the videos, to capitalize on the fact that farmers learn much from other farmers.

Objectives

1.) Develop four to six case studies of actual farms and farm families (including one limited resource farm) employing sustainable agricultural production practices. Farms will be located in Kentucky, Mississippi, and Tennessee, and will be representative of farms in the Southern Region. Prepare a 45-minute video, 5 minute executive summary, and a series of public service announcements which document the successes and failures of these farms in adopting sustainable practices, including specific economic and environmental impacts.

2.) Prepare supporting written materials for the case study video, including a facilitator's guide, economic and environmental analysis, and evaluation forms.

3.) Develop a condensed version of the video for public school teachers to pilot- test teaching about sustainable agriculture, to complement the Ag in the Classroom curriculum. Construct lesson plans to accompany the tape and facilitate its use by teachers unfamiliar with agriculture.

4.) Distribute one copy of all materials to each 1862 and 1890 land grant university.

5.) Present the concepts of sustainable agriculture to 500 farmers in Kentucky, Mississippi, and Tennessee by conducting 25 educational meetings and presentations. Educate 300 Extension agents and Farm Service Agency staff members about sustainable agriculture through in-service training. Increase the knowledge and awareness of farmers, policy makers, and the non-farm public about sustainable agriculture.

Approach

Ongoing whole-farm demonstration projects, such as Agri-21 Farming Systems, will be used to facilitate the development of the sustainable agriculture videos. Agri-21 Farming Systems is a program to demonstrate the technology required to conduct a profitable and sustainable agriculture. It is based on a whole-farm approach to management, and involves cooperating farms that undergo intensive evaluation and planning. Comprehensive sets of economic and environmental data are available from Agri-21 farms, providing a strong foundation for the development of educational case studies. Four to six Agri-21 farms (or farms from similar programs) will be identified in the three states. The farms will be selected based on a set of criteria, including profitability, resource conservation, environmental impact, farm family quality of life, and dedication to the principles of sustainable agricultural production.

Whole-farm case studies will be developed for each farm, emphasizing management changes which have occurred in order to achieve sustainability goals. The farms and farm families will be representative of a wide variety of farms. Ideally, the case farms should represent a number of farm types, including dairy, livestock, specialty, row-crop, and value-added enterprises. At least one limited-resource farm will be included in the case studies. Economic and environmental changes which have occurred in conjunction with the adoption of sustainable agricultural production practices will be evaluated with PLANETOR or other similar whole-farm analysis software.

A video will be produced which visually tells the story of the case study farms, with the majority of information presented by the cooperating farmers. For each farm, an overview of physical and financial resources will be presented. Farm family goals will be discussed, and successful adoption of sustainable practices to achieve those goals will be highlighted. One or more distinct themes will be developed for each farm, and these will be the basis for facilitated discussions and

exercises. The themes chosen will depend upon the specific farms selected.

Managing environmentally sensitive areas, enhancing soil and water resources, strengthening ties with rural communities, improving farm family and farm worker quality of life, increasing bio-diversity, integrating management and marketing decisions in a sustainable system, and increasing profitability are examples of the themes which are likely to emerge from the selected case study farms.

A five-minute summary of the case study videotape will be produced for use with agricultural policy-makers, and in settings where time does not permit the full-length videotape to be viewed. At least three public service announcements will be developed for broadcast by network and cable television.

To augment the videotape, a facilitator's guide will be written to provide an overview of the case study video, suggest methods in which the case studies can be used to achieve a set of educational objectives, and present logical break points at which the video might be suspended and group discussion engaged.

Supporting facts about the case study farms and background material relating to the themes highlighted for each farm will be presented in the facilitator's guide as well. Master copies of all handouts and overheads, suitable for duplication, will also be included in the materials.

The primary objective will be to develop the facilitator's guide for use by agricultural extension educators in teaching an audience of farmers. However, other types of educators and audiences will also be considered and addressed. For example, natural resource educators might use a subset of the case studies with an audience of community leaders; or human ecology educators might use one or more of the case studies with environmental groups.

A case study project steering committee (composed of farmers and educators) will be established during the initial stage of the project. The steering committee will set selection criteria for case study farms, assist in identifying and selecting the farms to be used as case studies, and review draft versions of videotapes and written materials developed in the project. Farm families from the case study farms will be featured in the videotape footage.

After draft versions of the materials are developed and approved by the steering committee, two evaluation meetings will be conducted with farm and non-farm audiences. The purpose of the evaluation meetings will be to obtain detailed feedback from meeting participants concerning the quality of the material presented, the types of information learned, and the appropriateness of the facilitator's guide. This feedback will then be used to revise the draft videotape and facilitator's guide to produce a final set of materials.

Following the evaluation and completion of the case study video and facilitator's guide, a second youth project steering committee will be appointed to develop a shorter, targeted pilot-test version of the materials for use in teaching youth. This steering committee will include teachers, Extension youth educators, and school administrators. The charge of this steering committee will be to guide the adaptation of the case study video for use with youth audiences, and to assist in the development of lesson plans or projects to accompany the youth version of the case study video.

Evaluations of the youth materials will be conducted by members of the youth steering committee, and this feedback will be used to develop the final set of youth educational materials. The completed youth materials will be used on a pilot-test basis in three classroom settings.

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Managing Soil Phosphorus Accumulation from Poultry Litter Application Through Vegetable/Legume Rotations

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Applying poultry litter at rates sufficient to meet crop needs for N results in P accumulation that can lead to non-point source pollution of surface waters. Legumes are able to use significant amounts of P and K. An advantage of using legumes for removing excess P is that no additional N fertilizer has to be applied since legumes can obtain N from the atmosphere through N_2 fixation. Including warm- and cool-season legumes for hay or silage in farm rotations may be one way to reduce excess soil P.

Objectives

1.) Investigate the use of warm- and cool-season legumes and legume-grass mixes in rotational cropping systems to remove excess P supplied by poultry litter;

2.) Evaluate cool-season legumes for P uptake efficiency following litter application rates on spring vegetables

3.) Monitor P, and K accumulation, N leaching, and P runoff in a vegetable-forage legume rotation system

4.) Demonstrate use of annual legumes in cropping systems, utilizing poultry litter as a nutrient source, on grower- owned land under grower conditions.

Factored experiments will be established at the Texas A&M University Research and Extension Center at Overton and Oklahoma State University Vegetable Research Station at Bixby. Crop yield and nutrient uptake will be determined along with accumulation of P and K and leaching of N by soil sampling and vacuum extraction tubes. Surface runoff of P and N will be monitored by use of flume catch basins. Results will be disseminated through normal Extension channels. Presentations will be made at vegetable, forage, and waste utilization, and regional and national professional meetings. Prairie View A&M University Extension Program - 1890 personnel will conduct on-farm demonstrations and disseminate results to farm operators and limited resource producers. Results will identify strategies that reduce non-point source pollution and soil nutrient imbalances and offer an opportunity for adoption of improved, environmentally sound management practices.

Approach

Factorial experiments designed to evaluate the objectives will be established at the Texas A&M University Research and Extension Center at Overton, and Oklahoma State University Vegetable Research Station at Bixby, in spring 1995 on plot areas whose integrities have been maintained. These plots received annual applications of poultry litter based on individual crop requirements for N over a three-year period (1992-94). Treatments ranged from insufficient (0) to 2X or 4X recommended litter rates based on crop N requirements. Poultry litter will be applied to vegetable crops only, based on N requirement ranging from insufficient to excess. Rates will be calculated on N content and percent moisture of the litter. A fertilizer blend will contain an approximation of all nutrients (concentrations) found in the poultry litter and will be applied to both vegetable and legume crop based on soil test results. Minor experimental design modifications based on specific resources and growing conditions will be made.

Selected plant factors to be evaluated depending on crop include growth (plant height, fresh weight, dry weight, leaf area, days to harvest), quality (soluble solids, firmness, color, pH, protein content, hollow stem, cracking), yield (size, number, weight, dry matter), plant nutrient levels (total N, P, K, Ca, Mg, and selected micronutrients), insect attraction (beneficial, harmful), and disease. These data will provide much of the basis for evaluation of economic efficiency associated with various treatments.

Accumulation of extractable P, as well as K, NO_3-N, Ca, Mg, and selected micronutrients in the 0-15 cm depth, will be determined in soil samples collected initially. Additional samples will be collected at the end of each growing season. To determine movement of nutrients through the soil profile, samples will be collected to 0.9-m depth by 15-cm increments to the first 30 cm and in 30-cm increments thereafter. Residual NO_3-N in the surface 15 cm will be used to determine the rate of litter application for the following vegetable crop. Soil solutions below the root zone will be

Project area

Waste Management

Project duration

March 1995-Dec. 1998

Budget:

SARE	$135,000
ACE	
Matching	$90,813

intercepted by vacuum extraction tubes equipped with porous ceramic tips. Surface runoff from plots will be determined by use of flume catch basins equipped with devices for sub-sampling runoff water. Sub-samples will be obtained each time any runoff is collected. Collected water samples will be chemically stabilized and stored immediately at 4° C until analyzed for soluble P, NO_3-N, and other elements as deemed necessary. Soil, plant, and water analysis will be by standard, published procedures (4, 25). The integrity of individual plots will be maintained each year for subsequent cropping and evaluation. Experimental data will be statistically analyzed using appropriate ANOVA, mean separation, and regression procedures depending on experimental design (18, 36, 39). Costs and returns of alternative production systems will be estimated reflecting actual market conditions. The application of experimental results to commercial production will be evaluated utilizing project results and estimating economic feasibility. Linear programming models will assist in determining the most profitable production systems under current economic conditions.

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Effects of Organic and Chemical Fertility Inputs on Soil Quality in Limited-Resource Vegetable Farms

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Small market biological vegetable farmers produce high economic return crops whose continued success is dependent on maintaining or enhancing the quality of their soil. The objective of this project is to study the effects of conventional, alternative intensive tillage and alternative minimum tillage fertility systems on the biological, chemical and physical factors that affect soil quality and crop yield on four vegetable farms in the mid-Atlantic region.

Farmers will be responsible for maintaining the production of the vegetable systems by implementing their normal practices on small experimental plots. Researchers will monitor and measure changes in soil quality associated properties and statistically analyze data. Extension specialists, researchers and farmers will summarize and present results in Extension fact sheets and journal manuscripts, at on-farm field days and at the annual Virginia Sustainable Agriculture Committee (VSAC) and Carolina Farm Stewardship Association (CFSA) sponsored sustainable agriculture conferences to help farmers, educators, consultants and researchers understand how to enhance soil quality. Researchers and Extension specialists will teach farmers simple techniques to measure and monitor changes in soil quality and, in conjunction with educators, demonstrate the use of such methods to other farmers at field days and conferences.

A group of farmers and researchers convened a workshop entitled "Effects of organic and chemical soil inputs on soil biota" in conjunction with the 1994 Virginia Sustainable Agriculture Conference, February 21-23, 1994. The workshop was sponsored by the Virginia Sustainable Agriculture Committee and the Southern Sustainable Agriculture Working Group to assist in establishing farmer-researcher linkages for developing sustainable agriculture research.

Objectives

1.) Compare and contrast the effects of conventional chemical methods and biological practices on soil biological, chemical and physical indicators.

2.) Assess methods to evaluate the effects of agricultural practices on soil quality indicators.

3.) Determine whether disease, insect and weed problems are different in organic and conventional systems.

The overall goal of the project is to answer the question, "Can the quality of soil in agricultural systems be improved by manipulation of inorganic and/or organic inputs?"

This project will enable farmers and researchers to achieve a better understanding of the soil attributes associated with soil quality and the practices that can improve soil quality. Producers participating in the program will learn to monitor and interpret changes in soil biological, physical and chemical properties that influence soil quality and, thus, empower them with the tools required to improve the productivity of their soils without detrimental consequences to the environment.

The results of this project will be extended to other producers, researchers, cooperative Extension agents and consultants to demonstrate the factors that affect soil quality and to encourage adoption of practices that enhance soil quality. In the long term, enhanced soil quality will improve the economic viability of farms and minimize environmental degradation.

Approach

Specifically the researchers will:

1.) Assess the effects of organic and inorganic soil amendments on selected soil biological, chemical and physical properties indicative of soil quality on four vegetable farms in the mid-Atlantic region.

2.) Teach vegetable farmers to perform simple on-farm tests to determine the effects of their production practices on soil quality.

3.) Develop fact sheets for distribution to farmers on:

a.) Effects of organic and inorganic fertility on the quality of soils in vegetable production.

b.) Sampling and monitoring soils for indicators of quality

4.) Conduct a field day at each farm for farmers, Extension agents, consultants and researchers to share the results of the field studies and the methods that farmers can use to monitor soil quality.

5.) Present the results of the study on effects of organic and inorganic fertility inputs on soil

Project area

Limited resource farms

Project duration

March 1995-Dec. 1998

Budget:

SARE	$184,319
ACE	
Matching	$79,351

quality at the Virginia Sustainable agriculture and the Carolina Farm Stewardship Association conferences.

6.) Write journal articles for the research community on the effects of organic and inorganic fertility inputs on soil quality.

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Developing Municipal/Farm Linkages for On-Farm Composting and Utilization of Yard Wastes: A Regional Resource Issue Project

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On-farm recycling of organic wastes may benefit both agricultural and urban and suburban communities. Composting yard wastes from non-farm communities with farm wastes can produce a valuable soil amendment and reduce the burden on urban and suburban landfills. The purpose of this project is to develop and document a program for distributing and composting yard wastes (deciduous tree leaves, turfgrass clippings, and shrubbery prunings) on farms for use as a soil amendment. A multidisciplinary team of researchers, Extension personnel, and waste managers will provide educational programs to introduce the concept to farmers, distribute the yard wastes, provide technical composting assistance, test the final product for farmers, and demonstrate soil quality enhancement and crop yield increases to compost application during field days at participating farms for farmers, local and state government officials and Extension personnel. The entire process will be documented in a manual and for electronic media to demonstrate how to conduct a successful program. This approach to utilization of quality organic wastes will enhance the productivity of agricultural soils, improve water quality, and reduce waste management problems and costs.

Objectives

The overall objective of this project is to develop a process for the recycling of organic wastes onto agricultural land and to document that process for implementation by waste managers throughout the southern United States. We will incorporate existing guidelines for composting and land utilization that are currently applicable throughout the Southern region. Specific objectives are:

1.) To develop a network of growers who will receive yard wastes, learn to compost, and utilize the finished product on their farms.

2.) To provide educational, technical and troubleshooting assistance to participating growers to ensure that they produce high quality compost for use on-farm.

3.) To create awareness in other, non-participating farmers of the soil-quality benefits of recycling organic wastes onto their land.

4.) To demonstrate the benefits of compost application on soil physical, chemical and biological properties and crop growth in on-farm tests.

5.) To develop a handbook and an electronic formatted version for use in the Southern region that provides instructions to waste managers for implementing a yard waste distribution system for farmers. This guide will be a collaborative effort between Extension specialists, farmers, waste managers and researchers that documents successful education, technology transfer, troubleshooting and demonstration processes.

Approach

The methodology described below will be implemented by a diverse, multi-disciplinary, multi-institutional group consisting of educators, researchers, and technical and administrative experts representing economics, waste management, and agriculture. The approach is described for each objective.

Objective One: The project will be initiated by developing a network of growers through a series of meetings in which farmers who have successfully composted leaves through the CVWMA program will be invited to Charlottesville (Albemarle County) to discuss with other farmers, Extension agents, Rivanna Solid Waste Authority personnel and Virginia Tech educators the following:

1.) Getting started in a composting program
2.) Benefits of composting
3.) Composting methods and materials
4.) Uses of finished compost
5.) Noted improvements in soil properties and crop yields and quality
6.) Problems encountered and future needs

Information from these meetings will be used not only by potential participants in a leaf distribution program, but by the educators and waste managers to avoid duplication of mistakes and ensure the success of the program. Steve Chidsey, the Solid Waste Director of RSWA and formerly of CVWMA, will be instrumental in identifying CVWMA participants and describing implementation of the RSWA plan for yard waste distribution. Charlie Goodman, Albemarle County Extension agent,

Project area
Waste management

Project duration
July 1995-Dec. 1997

Budget:

SARE	$69,167
ACE	
Matching	$24,522

will identify farms that represent various agricultural commodities, levels of composting sophistication and technology and need for organic soil amendments in the Charlottesville area.

Using the successful tactics learned from these meetings and experience from the previous Richmond area program, a leaf distribution program in the Charlottesville area will be established in the first 6 months of the project (July 1995 - December 1995).

Objective Two: From January 1996 - June 1996, the team of educators and technical experts will provide educational materials, and technical and troubleshooting assistance to the participating farmers. An economist will provide expertise on equipment and processing costs. Farmers, composting experts from Virginia Tech and Virginia State University and the program director from the Rivanna Solid Waste Authority will relay information to other farmers, Extension personnel and local government officials on:

1.) Contracting for municipal yard wastes.

2.) Understanding the regulatory process for on-farm composting.

3.) Composting principles and practices.

4.) Troubleshooting - stopping problems before they start.

5) On-farm uses of finished compost to improve soil quality.

Objective Three: As a plan to create awareness and recruit more adopters of waste recycling and composting, Extension personnel and local government officials will conduct 10 on-farm demonstrations of equipment, composting technologies and compost utilization at participating farms. These will be advertised through Extension, local farm bureaus and the Virginia Association for Biological Farming (VABF), the major alternative and biological farming organization in Virginia.

Objective Four: Farmers in the program will be asked to participate in on-farm growth trials using finished compost. Each participating farm will produce its commodity, e.g. vegetables, row crops, pasture species (forages), etc. with and without compost added to the soil. Farms will be representative of varying levels of composting sophistication and technology, need for organic soil amendments and marketing of the finished product. Farmers will employ typical fertility practices on the non-composted soil, but the compost treatment will receive compost only at the rates required to meet crop nutrient requirements.

Crops grown in areas with compost will be compared to crops in compost-free areas to demonstrate the beneficial effects of compost. Crop yields and evaluation of soil physical and chemical properties (exchangeable nutrients via soil testing, pH, CEC, soil organic matter, soil aggregate stability, water-holding capacity) will be determined before and after compost application and reported. Economic analysis to compare costs of off-farm inputs vs. compost costs will also be determined.

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LS95-72
Annual Report
December1995

Agronomic and Economic Benefits of Intercropping Bean with Banana

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Intercropping bean (*Phaseolus vulgaris L.)* with banana (*Musa acuminata* AAA) is practiced in some African countries and West Indies islands. The two crops are considered to be compatible because the beans do not offer severe competition with bananas and are a short-term crop having some degree of shade tolerance. In the humid mountain region of Puerto Rico, banana has a 12-14 month growth cycle. Any additional income that can be earned during the pre-harvest interval would be financially attractive to banana farmers. Intercropping banana with short-term cash crops deserves investigation under Puerto Rico conditions. The effects of planting time and frequency of intercropping on bean and banana yields will be determined in the first field experiment. Two bean cultivars, Arroyo Loro and PR 9443-1, will be intercropped with a banana cultivar, Grand Nain, at a private farm in the mountainous Naranjito area. Potential agronomic benefits, such as improved nitrogen fertility, weed control and erosion control believed to be provided by intercropped beans, will be determined under both field and laboratory conditions.

Further field experiments will be conducted at two private sites using the best planting time and frequency treatments selected from the first field experiment to determine the economic feasibility for establishing a bean/banana intercropping system. It is anticipated that information thus obtained would contribute to a sustainable production of banana in Puerto Rico.

Objectives

1.) To determine the effects of planting time and frequency of banana/bean intercropping on yields of both crops.

2.) To determine additional benefits of intercropping as contributions to nitrogen fertility, weed control, organic matter and soil and water conservation provided by intercropped bean.

3.) To determine the economic feasibility of the selected best planting time and frequency of bean/banana intercropping on a semi-commercial scale.

Approach

Objective 1: Two superior bean cultivars, recommended by the Bean Breeding Program of AES-UPR, Mayaguez Campus, will be used to intercrop with a banana cultivar, Grand Nain. The research will be conducted in a private farm owned by Mr. Antolín Rodriguez Matos of Anones ward, Naranjito Municipality. The farm is located in the north-central humid mountain region of Puerto Rico, about 600 m above sea level, and with a 30 to 40 percent slope. The soil is a deep, highly weathered, acid and of low fertility level. A randomized complete block design with four replications will be used. Treatment variables will include four planting times and two frequencies of beans to be intercropped with one cycle of banana.

Objective 2: The degree of nitrogen enrichment contributed by intercropped bean plants to banana plants will be determined by periodic sampling of banana leaf tissues obtained from the Objective 1 experiment, and by analyzing the tissue content of N (ammonia N, nitrate N and total N). Soil will also be sampled from bean-intercropped and non-intercropped plots for determination of nitrogen (ammonia N, nitrate N, and total N), and organic matter content. The latter will reveal possible residual soil effects of intercropped bean plants. The soil from the Objective 1 experiment will be sampled periodically to determine the contribution of organic matter from the intercropped beans. All chemical analysis will be performed at the AES-UPR Central Analytical Laboratory in Rio Piedras Research Center.

The contribution of weed control achieved by bean plants acting as a live mulch and light-excluding factor will be evaluated. Periodic weed population monitoring in different pre-measured areas will be performed. Broadleaf weeds will be differentiated from grasses.

Soil erosion losses will be monitored periodically on both intercropped plots and non-intercropped plots using the Universal Soil Loss Equation (USLE)(33) and Revised Universal Soil Loss Equation (RUSLE)(23): A= RKLSCP where A is the computed soil loss per unit area; R is rainfall and runoff factor; K is the soil erodibility factor (Revised under RUSLE); L is the slope-length factor (revised under RUSLE); S is the slope-steepness factor; C is the cover and management factor (revised under RUSLE) and

Project area

Cropping Systems

Project duration

March 1995-Dec. 1998

Budget:

SARE	$99,845
ACE	
Matching	$50,239

P, is support practice factor (revised under RUSLE). Ms. Maria M. Montes, Conservation Agronomist, of National Resources Conservation Service, Caribbean Area Office, USDA, will participate in this phase of studies. In addition, she will also measure the crop residue for both intercropped and non-intercropped plots using the line-transect method. It is anticipated to relate the intercropping effect on the site ecology.

The following data will be collected for this purpose:

1.) Determination of initial ground cover prior to and after seed bed preparation.

2.) Soil and site characteristics such as soil type, slope percentage, length of the slope and soil fertility prior to the research.

3.) Field mechanical treatment by dates.

4.) Additional structural measures that could modify the field features.

5.) Crop data such as biomass and residue production, canopy and root system development etc.

6.) Harvesting methods.

7.) Crop residue management techniques used during research.

8.) Soil fertility after completion of field research.

Objective 3: Two field experiments having identical treatments will be conducted at two separate sites using the best intercropping planting time and frequency chosen from the first experiment. Banana cultivar, Grand Nain, will be intercropped with a selected bean cultivar on a semi-commercial scale. All agronomic and pest management practices will follow the standard commercial practices for growing both crops.

All fixed and variable costs involved in producing different bean-banana intercroppings will be recorded. Gross and net incomes will be calculated for the above-mentioned treatments. The economic feasibility of adopting the best intercropping treatment will be determined. A partial budget analysis will be used to perform all the economic analyses needed to determine the best bean/banana intercropping system.

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AS92-1
Final Report
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An Integrated Technological and Marketing Strategy to Make Broiler Production More Sustainable

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Cooperators continued on ***next page***

Project area
Waste management

Project duration
Feb.1992-July 1995

Budget:

SARE	
ACE	$200,000
Matching	$125,940

The primary focus of the work has been to help private businesses, including farmers, earn income and create jobs through improved management of what many call "animal wastes." This project has allowed Winrock the opportunity to carry out a multifaceted community problem-solving effort that has involved farmers, small businesses, nonprofit organizations, elected community leaders and public agencies.

Objectives

1.) Identify and demonstrate economically and environmentally sound on- and off-farm litter and nutrient management practices that produce a consistent-quality litter for sale.

2.) Establish a more formal market for broiler litter in order to (a) make it easier for growers and contractors who clean broiler and turkey houses to find buyers, (b) increase the price of litter to its real economic value as a source of nutrients and organic matter for plant and animal production, (c) get more environmentally sustainable distribution of litter and (d) provide, when necessary, a price incentive to encourage more wise storage and application of litter and improve farm profitability.

3.) Improve poultry producers', clean-out contractors', litter processors' and end-users' knowledge of the interrelationships between production, processing, marketing and utilization of litter, its nutrient content, its value and its proper handling.

Approach

Analyze existing informal marketing practices. Winrock and project cooperators have conducted case study analyses of existing marketing practices through interviews with growers, integrators, clean-out contractors, row-crop farmers, ranchers, Extension agents and specialists, Natural Resource Conservation Service (previously Soil Conservation Service) field staff, conservation district technicians and others. This work established a baseline of how the existing, informal poultry litter marketing system works.

Develop strategies to reduce variability of litter. To determine potential for fractionation technologies being developed by the University of Georgia to separate "fines" for sale to a producer of bagged potting soil and the "coarse" fraction for reuse as bedding in the poultry house, University of Arkansas and Oklahoma State University faculty analyzed chemical and structural variability of litter removed from broiler houses at different locations in the house and following each of six flocks. The project has also evaluated how companies that are producing a "processed" litter control variability.

Encourage growers to invest in litter storage facilities. To increase flexibility in when litter can be sold, purchased, delivered and used, project staff and cooperators have evaluated methods of storing litter in cost-effective and environmentally safe ways.

Bring buyers and sellers together. To facilitate contact between potential buyers and sellers of litter, Winrock established a 1-800 "poultry litter marketing" telephone hotline and developed informational and educational materials to tell farmers about the hotline and its use.

Improve buyers' and sellers' knowledge of litter prices. Winrock and the Arkansas Cooperative Extension Service have used data from the 1-800 hotline and other sources to track prices paid by farmers for litter. Winrock and project cooperators have shared this information through publications and individual consultations.

Identify and develop educational programs for clean-out contractors. Winrock staff and project cooperators have identified clean-out contractors who are active in Arkansas and Oklahoma. Those that indicated a particular interest in selling litter outside the area where it was produced have been sent educational materials on handling and marketing of litter throughout the project.

Identify, evaluate and arrange least-cost transportation of litter. Winrock staff and project cooperators have evaluated various methods available to transport litter from western Arkansas to eastern Arkansas. Particular emphasis has been placed on determining the opportunities for back hauls by trucks, railroads and barges currently traveling empty from poultry production areas to areas where litter can be used.

Recommend strategies to increase demand for litter. Winrock staff and project cooperators have explored opportunities for increasing use of poultry litter as a cattle feed, particularly for use in feedlots and as a means of restoring productivity to soils damaged in various ways. Particular attention has been paid to the marketing efforts and problems of firms that are processing litter into higher-value products.

Results

This project has expanded the knowledge base of how litter was being handled in the state. As assumed in the original proposal, we found that farmers and others are very innovative in the ways they use litter. People with concerns about the economic or environmental well-being of the state have used the new knowledge generated by this project and been given opportunities to work and learn together for the common goal of sustainable poultry production that is environmentally sound, economically viable and socially acceptable.

Many poultry farmers now have an opportunity to sell their litter at a fair price, while reducing a threat to water quality on their farm or in their communities. Some poultry farmers have been able to sell litter for the first time because of this project. Previously, they were giving it away to simply get it off the farm.

Crop farmers who have seen the productivity of their land reduced because of precision leveling or because of other soil problems now have an opportunity to purchase poultry litter at a fair price and restore productivity. While there is no way to precisely determine how much litter this project has helped move from western Arkansas where it can cause water quality degradation to areas where it can be productively used, project staff and cooperators believe that a conservative estimate of 150,000 tons were marketed as a result of this project in 1994. Working in cooperation with the Central Arkansas Resource Conservation and Development Council, the project has helped purchase five litter spreaders and locate them in counties where a demand for litter has been observed, but no equipment was available to farmers to spread the litter.

Paul Brown, project coordinator, assisted the Central Arkansas Resource Conservation and Development Council in securing a grant from the State of Arkansas of more than $50,000 to purchase litter spreader equipment. This equipment was placed in row-crop areas of the Delta to facilitate litter application. As a result the market for litter has been expanded because farmers do not have to locate a contractor.

Winrock, in conjunction with the Central Arkansas Resource Conservation and Development Council, established a Cost Share Program to demonstrate the feasibility of targeting litter removal from critical watersheds. The program provides cost incentives to Delta farmers to cover extra transportation costs for transporting litter from identified critical watersheds in remote areas.

Marketing strategies to link litter buyers and sellers together have been developed and seem to be sustainable. Independent business men and women have started firms to market litter.

This project was the first to report that about 70 percent of the poultry farmers were hiring clean-out contractors to remove litter from their broiler and turkey houses. In many ways these businessmen determine whether poultry litter is properly or improperly applied on farmers' fields. Previous to this project all best management practices, regulations, educational programs and financial incentives to encourage proper management of litter have been directed to farmers. As a result of this project, educational materials are being prepared for clean-out contractors and educational programs for these individuals will be offered by the Cooperative Extension Services in Arkansas and Oklahoma.

Truckers, including farmers and clean-out contractors with trucks, can now haul bedding and litter in the same truck as long as the trailer is cleaned after hauling litter. This has helped reduce the cost of handling litter and made it a more marketable product. Several "litter brokers" have made it possible for independent truck owners and operators to obtain loads when they return from western Arkansas and eastern Arkansas. This allows them to at least cover the cost of returning to their home bases.

Cooperators continued:

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Agriculture in Concert with the Environment
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AS92-2
Annual Report
December1995

Habitat Enhancement for Beneficial Insects in Vegetable and Fruit Farming Systems

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Project area
Beneficial insects

Project duration
Feb. 1992-Jan. 1995

Budget:

SARE	
ACE	$200,000
Matching	$79,975

Objectives

Many species of predatory and parasitic arthropods exist, including ladybugs, lacewings, parasitic wasps and flies, minute pirate bugs, big-eyed bugs, and spiders. Often referred to as "beneficials", they can play and important role in reducing numbers of insect pests. However, in order for these natural enemies of insect pests to survive and multiply, they need nectar and pollen, alternate prey, water, shelter from wind and rain, and overwintering sites. Some of these habitat needs can be met by increasing plant species diversity in our agricultural production systems.

Which plant species are most attractive to "beneficial" insects? Can we design diversified planting systems that will reduce pest damage to vegetable crops? Can these systems be profitable and practical to manage?

These questions were the basis for work begun in 1992 on farms of 10 vegetable growers in Arkansas and Oklahoma, and at Oklahoma State University, Arkansas State University, and Auburn University research stations. Two of the Arkansas farms belong to and provide educational demonstrations for non-profit organizations. The other 8 farms range in size from 12 acres to 220 acres, with 1/2 to 4 acres used for vegetable production. All grow a diversity of vegetables, fruits, and flowers.

Approach

To answer the first question, participants observed insect activity on plots of wildflowers, herbs, and legumes. Plants noted by many farmers as being highly attractive to beneficial insects include basil, cilantro, dill (and all flowering plants in the umbel family), yarrow, buckwheat, and crimson clover. Other flowers noted by 1-2 farmers as highly attractive were anise hyssop, garlic chives, mints, goldenrod and other native plants in the composite family, and a commercial mix sold as Good Bug Blend.

To answer the second and third questions, farmers and researchers compared cabbage grown with companion plants to cabbage grown without companion plants. Based on their experience and observations, farmers evaluated several strategies for incorporating "habitat enhancing" plants into cropping systems.

Companion planting (a mix of different species of plants within a row or bed) was rated as difficult to manage due to varying cultural needs of species i.e. planting time, harvest time and methods of planting and harvesting.

Strip planting (alternate rows or beds of "habitat" plants and vegetables) were rated as most easily adapted to vegetable production systems. One grower planted strips 4' - 8' wide alternately with strips of vegetables about 25' wide. Another grew vegetables in beds 65' X 4' with every 6th bed planted to perennial or self-seeding wildflowers or herbs. Growers and researchers saw additional benefits to planting vegetables in strips mowed or tilled through winter cover crops (clovers, vetches, alfalfa, oats, rye . . .) In addition to habitat for insects, the cover crop residue provides weed suppressing mulch, organic matter, nutrients, and erosion prevention.

Border plantings (fence rows, field edges, or islands of "habitat" plants) was also rated as reasonably adaptable.

In all systems, cooperators agreed that diversity is desirable. Bloom period can be extended with a variety of species. Cooperators also agreed that habitat plants should have additional value to the farmer as cut flowers, herbs, green manures, or forages. For example, dried yarrow flowers can add value to garlic braids; cover crops improve the soil; the beauty of flowers in the garden adds pleasure for PYO customers. "Ambience is very important on our farm," commented one project farmer.

The value of the project is indicated by statements made by participating farmers:

"I always wanted to plant more winter cover crops. I did so this winter for the project - now I will keep on doing it."

"From now on, we will plan our plantings so that we always have members of the umbel family (dill, cilantro, parsley, carrots, fennel) in bloom throughout the growing season."

In regard to a non-cultivated area containing vetch, various grasses, black-eyed Susan, lambs quarter, gaillardia, lemon mint, dill, crimson, clover, and buckwheat, "One can hardly object to a field of such plants . . . Indeed, they are a joy, they came up this year by themselves, and to an important degree, they replace other less desirable plants. This area at my place is 'crawling with insects', in contrast to my clean-till plot."

Farmers cited interaction with other farmers, learning new things, and contributing to knowledge about sustainable agriculture as important benefits from their involvement with this project. They are sharing what they learned with other farmers and with their customers on a daily basis. A "case studies" book detailing the operations of project farmers is planned.

The above report was submitted in 1994. No report was submitted for this project in 1995.

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AS 92-4
Annual Report
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CROPS, the Crop Rotation Planning System for Whole-Farm Environmental and Economic Planning

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The CROPS system is a computer program that addresses the farm-level problem of sustainable agriculture: how does a farmer implement sustainable practices on a particular farm? Given a set of goals for production levels of specific crops, a map of the farm's fields with associated soil and topographic data, and economic information about the farm, the CROPS program generates one or more whole-farm plans over a six-year planning horizon. The plans are repeating; they meet the requirements of the NRCS; and they incorporate the principles of sustainable agriculture, promoting reduced leaching and runoff of nutrients and pesticides while maintaining economic profitability.

Objectives

The goals of this project were to expand the applicability of CROPS to include relatively unconstrained farming operations like vegetable producing farms, to add more detail in the areas of livestock and manure management, and to provide for field testing by four cooperating farmers in two states. Specific objectives were:

1.) Implement and evaluate a whole farm planning system (CROPS) to assist farmers in developing crop rotation plans, adopting environmentally sound practices, and complying with state and federal land-use regulations.

2.) Expand the livestock component of the CROPS system to include manure management.

3.) Improve the economic evaluation component of CROPS and establishing data and file-transfer linkages with the PLANETOR program (Hawkins et al. 1990).

4.) Modify CROPS for vegetable production systems and test it on a small scale vegetable farm.

Methods

The methodology for implementation and evaluation was straightforward: demonstrate the planner to farmers and agricultural agency planning experts, and modify the system as needed in response to the critiques elicited. Revisions to the CROPS system were interactive and based on a participatory process. Teams of two to six specialists worked with the programmer and project coordinator to design, implement, and supervise the testing of aspects of the program as it was developed. This participatory approach has provided several new features to the CROPS system and has greatly increased user-acceptance of the program and its enhancements.

Efforts to improve the economic component of CROPS focused on two tasks: moving toward a comparative approach and helping farmers determine what an optimal crop mix might be in the absence of environmental constraints. This economic optimum becomes the default target crop mix in situations in which the farmer wants to explore new options. Researchers also aimed to standardize the enterprise budgets in CROPS to make them consistent with those in PLANETOR and to import the plans generated from CROPS into PLANETOR.

To address the specific problems of vegetable production, the researchers expected to use a planning methodology based on "simulated annealing," a solution method for complex problems involving multiple combinations of options that don't lend themselves well to simple mathematical description. However, this task was the most speculative of the proposed work, and based on an initial review of the vegetable planning problem with experts and the cooperating farmer, they abandoned this approach and initiated research into hierarchical planning methodologies that can deal with planning at multiple levels of specificity.

Results

Based on user evaluations, it was learned that the program would have to generate plans that were more flexible and be able to produce more reports and educational materials. The nutrient management and economic summary aspects of the program needed more development and detail. These needs were addressed through development of new algorithms and routines.

Based on the expertise of several nutrient management specialists, new algorithms were developed for computer inventory of animal manure production, storage, and nutrient content. Further algorithms were developed to constrain the application of animal manure to specific fields based on field characteristics, environmental hazards, and crop nutrient needs. A stand-alone program was developed to test the nutrient manage-

Project area
Systems planning

Project duration
Oct.1992-Jan.1995

Budget:

SARE	
ACE	$140,000
Matching	$91,702

ment algorithms and this program has been extensively tested by the state's nutrient management specialists. The stand-alone program includes new features: inventory of animal manure production, storage, and nutrient content; field manure level constraints based on field characteristics; a new algorithm for determining crop yields and nutrient needs based on soil, topology, and management considerations.

Improvements to the economic component of CROPS were made in the basic design of the problem and in crop target selection. The system was modified to allow the entry and display of economic information based on a comparison to the current or "benchmark" scenario.

Also, an optimal crop target selection program was added to allow farmers to use the system in a more exploratory way. This optimization component is itself a major accomplishment, allowing farmers to request an optimal crop mix for the specific fields on their farms and including the full range of constraints from the farm program and the 0-85 option.

Working closely with agencies dealing with environmental stewardship, significant progress was made toward the goal of providing farmers with integrated, multiple-objective and multiple resource plans. Perhaps the most significant stride was the decision by NRCS (formerly the Soil Conservation Service) to support the inclusion of CROPS in their field office computer system (FOCS). This means that the whole-farm planning concept in CROPS will influence farm planning nationwide, helping NRCS to promote total resource conservation and sustainable agriculture.

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AS93-7
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Evaluation of Recycled Paper Mulch as an Alternative to Black Plastic Mulch in Vegetable Horticulture

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Many vegetable farmers use black plastic film mulch on tomatoes, cucumbers and other warm-season vegetables because plastic blocks weed growth, conserves soil moisture and warms the soil thereby promoting early crop maturity. However, plastic does not add organic matter or nutrients to the soil, its manufacture consumes considerable fossil fuel, and its disposal adds to the nation's solid waste burden. Some growers use paper mulches, including a commercially available black paper mulch, newsprint end rolls and other paper wastes as biodegradable alternatives to plastic. However, these materials do not warm the soil as effectively as plastic, and they often break down too fast, with resulting loss of weed control.

On many small, biologically managed farms, organic mulches such as hay, straw or leaves are used to provide organic matter and nutrients, protect and improve the soil, and suppress weeds. However, these materials cool the soil, which may delay ripening in tomatoes and other summer vegetables. Also, they may be too expensive and labor-intensive to apply on larger farms. Growers and researchers have experimented for the past several years with winter cover crops that are killed by mowing in spring and left in place as a mulch. Results have varied from disappointing due to inadequate weed control, to excellent with tomato or squash yields exceeding those with plastic mulch. This approach merits further development.

Objectives

The overall goal of this project is to assist vegetable growers in developing optimal mulching strategies for their farms. Specific objectives include:

1.) To identify advantages and problems of different mulches used by vegetable growers, establish research priorities, and engage growers in the process of developing and disseminating information on mulching systems.

2.) To evaluate recycled paper, vegetable oil-impregnated paper, and organic mulches as sustainable alternatives to plastic film mulch.

3.) To disseminate information on horticultural, soil, economic and ecological merits of different mulches so growers can make informed choices appropriate to their specific sites and operations.

4.) To identify safe and cost-effective means to utilize waste paper as a mulching material.

Approach

Field experiments were conducted at five biologically managed working farms in Virginia in 1993-94 to evaluate recycled kraft paper, oiled paper, hay and other organic mulches as alternatives to black plastic mulch for tomatoes. None of these alternative duplicated the early yields and superior weed control obtained with plastic. Organic mulches cooled the soil and somewhat delayed maturity, although *total* yields equaled those for plastic-mulched tomatoes. Paper treated with waste cooking oil dramatically warmed the soil early in the season, but weeds broke through this mulch. However, results indicated that plastic may not always be the best choice for tomatoes, especially in hot dry weather, when crops growing in the cooler organic mulches suffered less stress and gave more sustained production.

During 1993-94, 72 vegetable growers were interviewed to learn about existing mulching practices and innovations, and to engage growers in the process of proposing, testing and implementing new mulching strategies. A majority of participants prefer hay and straw mulches because they conserve soil moisture, add organic matter, reduce weeds and support good crop yields. Although growers noted the advantages of plastic, many raised environmental and waste-disposal concerns, and some have stopped using plastic for these reasons. Some growers reported using paper or killed cover crop mulches, and others expressed interest in experimenting with these materials.

Interview participants received reports on the findings of this survey and of field trials conducted in 1993-94, and were invited to participate in designing and conducting mulch experiments during the 1995 season. Seven growers responded to this invitation, and worked with the project coordinator to design and conduct on-farm experiments to address questions of particular interest to each grower.

Several growers in the survey suggested using two to four layers of newspaper under an or-

Project area
Vegetable production

Project duration
March 1993-Dec. 1996

Budget:

SARE	
ACE	$40,000
Matching	$10,182

ganic mulch to enhance weed control or soil moisture conservation, and one recommended newsprint end rolls (available free at newspaper printing presses) because they are easier to apply and are free of inks.

Results

Experiments were conducted on five farms to evaluate this strategy, and the paper substantially improved weed control at four of these sites. Five tons per acre of hay (~ one 35-lb square bale per 150 square feet) laid over two thicknesses of newsprint controlled weeds as effectively as 10 tons hay per acre without paper. Heavy applications of hay or straw can be expensive, and may upset the mineral balance of certain soils. Thus the use of paper to improve weed control by light applications of organic mulch is a significant grower innovation that has now shown promise in replicated trials.

Four growers hosted on-farm experiments with oiled paper mulch as an alternative to plastic. One participant successfully laid a small roll of oiled, heavy-duty kraft paper with a tractor-drawn plastic mulch layer, a key step toward implementing paper mulching on larger farms. Oiled kraft paper and a double layer of oiled newsprint warmed the soil early in the season, whereas a commercial black paper mulch did not. Both oiled paper mulches lasted longer than the black paper, and controlled weeds adequately, though not as completely as plastic. Participating growers expressed interest in further exploring oiled paper mulch.

In the course of conducting this project, it became apparent that choosing the "best" mulch is inherently a site-specific process. Crop, soil, climate, availability of mulching materials, and the farm's scale, machinery, financial and other resources must all be taken into account.

The question, "what is the best mulching practice for this crop?" can best be answered through an integration of relevant research information with the grower's own ingenuity, knowledge and experience with his/her farm.

The objective for the remainder of this project is to develop and disseminate information on various mulching materials and their interaction with crop and soil, that will assist vegetable growers in developing ecologically and economically sound, site-specific mulching strategies.

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Sustainable Agriculture Research and Education
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AS93-8
LS94-64
Annual Report
December1995

Development of Suitable Area-Wide Weed Management Practices for Improved Land Utilization

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Objectives

Musk thistle, an introduced plant, is a noxious weed that impacts land utilization over a broad geographical region. This weed grows in many areas that are inaccessible and uneconomical for herbicide use or mowing. A project to develop and integrate a sustainable weed management program incorporating the release and establishment of two introduced thistle-feeding biological control agents was initiated with cooperators from Georgia, North Carolina, Tennessee, and Virginia. This multi-disciplinary (entomology, agronomy, and agricultural economics), multi-institution/agency (North Carolina Department of Agriculture, Tennessee Department of Agriculture, Tennessee Department of Transportation, University of Georgia, The University of Tennessee, and Virginia Polytechnic Institute and State University), and multistate (Georgia, North Carolina, Tennessee, and Virginia) project involves research and Extension entomologists, agronomists, agricultural economists, numerous grower and state organizations, and farmers.

This regional project emphasizes farmer education and the functional integration of research technology for implementation of sustainable management of musk thistle into ongoing farm systems. The overall goal of this project is to develop and integrate a sustainable weed management program that incorporates the release and establishment of two introduced thistle-feeding biological control agents. These two agents feed specifically on thistle and pose no threat to agricultural crops.

These biological control agents have been evaluated, and are established, in Virginia, where they effectively provide sustainable control of musk thistle. Research knowledge from previous studies in Virginia will be transferred and developed into a practical, integrated sustainable management program for surrounding states. Once developed, this program can be easily adapted by personnel in other states for sustainable management of musk thistle. The specific objectives of this proposal are to:

1.) Establish and maintain on-farm field insectaries in Georgia, North Carolina, Tennessee, and Virginia for propagation of two introduced thistle-feeding biological control agents.

2.) Develop a distribution plan to provide biological control agents to landowners and agencies for release in thistle-infested areas.

3.) Develop and implement a regional educational program (through grower education days, field days, county meetings, publications, etc.) to improve public awareness of sustainable management systems using this program as a model. The educational program will be directed at numerous targets including farmers, landowners, schools, organizations, and state and federal agencies.

4.) Assess the economic and environmental benefits of this type of sustainable weed management program.

Approach

During the second year of this project, about 46,000 biological control agents (i.e., two types of plant-feeding weevils) were released against musk thistle at locations in Georgia, North Carolina, and Tennessee. About 5,200 head weevils, *Rhinocyllus conicus*, and 9,300 rosette weevils, *Trichosirocalus horridus*, were collected and redistributed on thistle-infested farmland in Tennessee. Approximately 7,000 head weevils were collected in Tennessee and provided to cooperators for release on farmland in Georgia (800) and North Carolina (6,200), and about 3,000 rosette weevils were collected in Tennessee and released on cooperating farms in North Carolina.

During 1995, 1,120 head weevils and 3,600 rosette weevils were collected in Virginia and released in Alabama, Georgia, Oklahoma, and Virginia. Head weevils (ca. 2,000) and rosette weevils (760) were redistributed in North Carolina; head weevils (ca. 15,500) were redistributed in Georgia.

In 1995, weevils were released at about 45 sites in 11 counties in Georgia, in 4 counties in North Carolina, at 60 sites in 15 counties in Tennessee, and at several sites in one county in Virginia.

On-farm and off-farm demonstration sites and field insectaries were established and maintained in Georgia, North Carolina, and Tennessee. Two field insectaries also were maintained in Virginia for propagation of biological control agents.

During 1995, this regional project was out-

Project area
Weed management

Project duration
March 1993- Dec. 1996

Budget:

SARE	$3,760
ACE	$161,240
Matching	$133,000

lined and discussed with numerous county Extension agents and farmers, as well as at various grower meetings, field days, and scientific meetings. Because this program is relatively new to Georgia, North Carolina, and Tennessee, much continued effort was placed on contacting and explaining this project to county agents. Additional cooperators were aligned and field insectaries were designated. Information on this sustainable weed management program was distributed through various media outlets (e.g., letters, publications, grower meetings, field days, television reports, and professional meetings).

Results

This environmentally safe and economically sound management program is expected to provide environmental, economical and social benefits. These include reduced herbicide use, improved pasture management, improved water quality, improved land value, reduced fossil fuel and labor costs, reduced impact on non-target organisms, reduced risk of exposure to herbicides, reduced herbicide residues, and reduced costs of weed management (e.g., in Missouri and Virginia, management agencies and farmers save from $750,000 to $1,000,000 annually in reduced herbicide use compared to previous conventional practices).

Reducing musk thistle populations to lower levels will eventually lead to an increase in available pasture and crop lands. Valuable efforts expended to control musk thistle could be allocated more effectively and efficiently on crop or livestock production. Establishment of this biological control system should provide a self-perpetuating, sustainable control system capable of being implemented over wide areas. This project should also reduce environmental pollutants, thereby protecting the environment and natural resources.

Management of weeds, such as musk thistle, using sustainable systems will demonstrate a positive approach to the current global concerns over environmental and groundwater contamination by pesticides.

This program should demonstrate the effectiveness, ease of adoption and incorporation, and economic and environmental benefits of an integrated biological control program for successful area-wide sustainable management of musk thistle. This program should also contribute to education of farmers and the general public as to the benefits of sustainable biological control programs. The success and educational benefits of this program should encourage more use of biologically sustainable programs in other states.

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AS93-9
LS93-56
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Using Soldier Flies as a Manure Management Tool for Volume Reduction, House Fly Control and Feedstuff Production

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Objectives

The overall objective is to develop a system to manage a native nonpest soldier fly larvae (SFL) to; (1) reduce manure accumulations where livestock is housed, (2) eliminate house flies and (3) produce tonnage of high quality feedstuff. Currently this system is being developed for caged layer houses and specific objectives are:

1.) Determine depth of manure basin necessary to allow SFL to utilize manure accumulated during the previous winter.

2.) Characterize plant nutrients in layer manure with and without SFL.

3.) Evaluate manure volume reduction, esp. of winter accumulation.

4.) Evaluate SFL feedstuff production, quality and utilization.

5.) Determine feasibility of using this system in high-rise layer houses.

The black soldier fly (*Hermetia illucens*) occurs worldwide in the tropics and temperate regions. The larvae of this large, wasp-like fly occur in very dense populations on various organic wastes and excludes other flies. We are developing a manure management system for caged layers using soldier fly larvae (SFL). In our system, wild populations of SFL are managed in concrete basins under the hens (could be hogs or cattle) to:

1.) Eliminate house fly breeding.

2.) Eliminate half of the manure through incorporation into larval biomass.

3.) Produce large quantities of high quality feedstuff (42 percent protein, 35 percent fat) through *self-harvest* of prepupae (ca. 65 tons/ 100,000 layers annually). SFL convert manure to "meat" about as well as hogs convert their feed.

This system will greatly reduce manure handling and pollution potential and increase feedstuff production. This contribution of high quality feedstuff could be a huge benefit to the livestock industry, especially if world menhaden (fish meal) stocks continue to decline. Twenty-three thousand tons of dried larval feedstuff with a minimal value of $7 million could be produced in the Georgia layer industry each year. If adapted to broilers and swine, over a larger geographic area this would be multiplied many times. Environmental benefits may be more valuable than direct economic returns.

Utilization of the larval feedstuff has been extensively studied. It has been successfully incorporated into the diets of poultry, fish and swine with hogs actually preferring a larvae based diet over a soybean diet. One of the most remarkable things about this system is that the larvae self-collect themselves. They do this as they are leaving the manure basin to transform into the adult. At this stage they are at their maximum size, with a large store of fat. This fat is to sustain them to adulthood, but is a valuable feedstuff. This stage does not feed. Considering their diet, this is a definite plus.

Approach

The 24-by-60-foot experimental caged layer house was completed and 1700 layers were installed in September 1994. About 41,000 SFL were released into the outer two pits (there are four pits) where they were managed. The inner two pits were sprayed with Larvadex® to eliminate any larval activity. Soldier fly activity had almost stopped when hens were installed in late September. The larvae that were released overwintered in the general area, emerged as adults in April and laid their eggs.

One main objective was to determine if SFL could digest the stockpiled, winter-accumulated manure. If this was successful it would have almost doubled the benefits of manure reduction and feedstuff production. In previous studies SFL had been successfully used to manage manure as it was produced in the warmer months of April to October.

Results

Unfortunately the deep, dry base of older manure caused two problems; failure of prepupae to exit the pit to self-harvest and a darkling beetle outbreak. Also, there was a house fly outbreak in the fall just after hens were introduced. None of these problems had occurred in previous studies with a spring manure clean-out and an established SFL population in-place through the fall and winter.

The commercial scale manure basin was ef-

Project area
Manure management

Project duration
Sept. 1993-April 1996

Budget:

SARE	$2,150
ACE	$49,100
Matching	$25,626

fective in harvesting the prepupae that did attempt to exit and manure clean-out was routine with a small Kobuto tractor with front-end loader. A March 1996 clean-out is scheduled, after which it is expected a more typical SFL population to develop and allow the other study objectives to be achieved.

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AS93-11
AS94-11.1
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Use of Poultry Litter or Manure for Root-Knot Nematode Management on Vegetables and Field Crops

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Objectives

Poultry is a large agricultural industry in the southeastern United States. The poultry industry generated an estimated income of $480 million in South Carolina and $1.5 billion in Georgia during 1995. In addition to providing income and food products, the industry generated an estimated 3 million tons of waste in South Carolina and Georgia during 1995. Although poultry is a significant economic component of agricultural income in the southeastern United States, it also presents a significant challenge to manage and utilize the waste that is generated. Poultry manure contains significant quantities of fertilizer [Nitrogen (N), Potassium (K) and phosphorus (P) and micronutrients]. Application of litter or manure to land has been viewed as a substitute for mineral fertilizers and as a method for disposing of unwanted waste. The N, P and K components in the manure are equivalent to an estimated $61 million of inorganic fertilizer.

Root–knot nematodes, a debilitating plant root parasite, are common in southern soils and are a serious problem on vegetable and field crops. On just two row crops in South Carolina (cotton and tobacco) an estimated $10 million are spent annually on nematicides to control nematodes, whereas in Georgia an estimated $54 million are spent annually to control nematodes on cotton, tobacco and peanuts.

As a result of widespread infestations of root-knot nematodes, nematicides are commonly used in many cropping systems with the potential of contaminating surface and ground water. Nitrogen-rich organic amendments can be used to suppress root-knot nematodes and may provide an alternative to synthetic pesticides.

The specific objectives are to:

1.) Determine if poultry manure or litter (which form is best) can be used, at environmentally sound application rates, to provide fertilizer (N, P, K and micronutrients) for a crop and suppress nematodes.

2.) Determine if the nematode suppression is due to the ammonia in the manure and litter or to organisms in the manures.

3.) Encourage the farm community to utilize this valuable resource.

Approach

Litter and manures were collected in South Carolina and Georgia and evaluated for their ability to provide plant available nutrients and suppress root-knot nematodes on cotton, tomatoes and squash. Tests were conducted in the field on experiment stations, on farms, in greenhouses and also in several controlled environment chambers.

Manure and litter applications rates were based both on a weight basis (tons per acre and also on a total nitrogen content of the litter and manure [90 pounds of N/acre]. It is important to apply only sufficient nitrogen to assure crop growth. Any nitrogen source, either organic or inorganic, if applied in excessive rates may pollute groundwater. Since the researchers also wanted to see if manure and litter, when applied in quantities suitable for nitrogen application, suppressed root-knot nematodes, fields were selected with a history of root-knot nematode problems (soil artificially infested in Georgia).

Litter and manure were applied in fashions that a farmer would normally use (distributed on the land and incorporated by machinery). Crop growth (yield, leaf and shoot growth, nitrogen in fruits and leaves), nitrogen form (in soil) and nematode development (nematode induced root damage and numbers of nematodes) were recorded.

Litter was examined to determine what microorganisms were present. Bacteria and fungi were isolated from the manure and tested to see if extracts from the organisms affected nematode development. Researchers in South Carolina worked on nitrogen form whereas researchers in Georgia worked on the potentially suppressive organisms present within the litter.

Results

To date, the work has demonstrated the ability of poultry litter and manure soil amendments to suppress root-knot nematodes in squash and cotton, two high-value intensively managed crops. In squash, yields were comparable to inorganic fertilizer commonly used in commercial squash production and in one field where nematodes were present, litters and some manures reduced nematode damage.

Barriers to using poultry litter or manure for

Project area
Waste management/pest control

Project duration
July 1993 to Dec. 1996

Budget:

SARE	
ACE	$146,692
Matching	$135,000

nematode suppression include a lack of understanding of 1) the effects of nitrogen form (proportion of total nitrogen as NH_3 within different manures) and 2) the role of microorganisms present within the litter or manure on nematode populations. In order to best utilize this resource we need to know what is actually suppressing the nematodes and if all life stages of the nematode are equally affected. Several life stages (eggs, larvae or nematodes protected within root pieces) were evaluated for sensitivity to litter or manure application. This information will enable researchers to maximize the factors responsible for nematode suppression while utilizing the nitrogen present in the manure.

As this project proceeds, a greater understanding of the mechanisms involved in litter and manure-induced suppression of nematodes and crop nutrition will enhance our abilities to integrate the reliable use of manure and litter into commercial production units as a nitrogen source and as a nematode control agent.

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Waste Management System for Loafing Areas in Dairies

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Dairy loafing areas present unique waste management problems that are not being addressed under present farm practices. These unpaved areas leading to milking barns have high animal densities and can be a source of contaminated surface runoff and subsurface leachate to groundwater.

Objectives

This project examines an innovative waste management system recently installed in the participating farmer's loafing area that will capture subsurface flow in buried drains and route this to the lagoon. Surface runoff has been reduced through the use of an economical geotextile fabric covered with fine gravel. The drains have been installed under half of the loafing area so comparisons can be made with soil sampling, ground electromagnetic inductance measurements, and groundwater sampling to determine if the drains significantly reduce nitrate leaching.

The Region III Office of the Environmental Protection Agency has agreed to provide additional funding to install an identical system at a second farm located in Oglethorpe County, Georgia. Results will be rapidly disseminated to the farming community within the Hydrologic Unit through an established interagency education program and to the scientific community through conference proceedings and refereed journal articles.

With four months now remaining in the project most of the objectives related to installation of the primary loafing site and planning of a secondary site are in place. The remaining project effort will be directed at initiating the monitoring and data collections phase of the project.

Approach

One loafing system was installed on the farm of J. R. Waller, Jr. in Putnam County, Georgia during December 1994. The area was fenced by late spring and an initial electromagnetic survey (EM) was conducted on June 28, 1995. Additional EM surveys are planned as a long-term effort to monitor the development of surface and any possible groundwater contamination from manure deposition on this loafing lot.

NRCS worked with the farmer cooperator, installing a pond and walking lane across a creek that separates the pastures from the milking area, as well as a new lagoon, a settling basin, solid separator and irrigation system to pump down the lagoon. NRCS contributed more than $100,000 in funds to develop this site.

The producer currently milks 60-70 cows and intends to expand to about 150 milking cows. The farm has approximately 100 acres of open pasture. A flushing system in the milking barn drains to a half acre lagoon. The loafing area (150 x 150 ft) was moved to an area adjacent to the barn that is currently not being used and is at an elevation that will allow drainage to the lagoon.

Monitoring equipment is currently being installed to measure surface runoff and subsurface drainage. A three-inch parshall flume was installed in June, and calibration of a sonar system to measure height of flowing water has just been completed. This sonar will allow measurement of height in the flume to 45 cm with an error of less than 2 mm over a temperature range of 5° to 40° C. This results in a relative error in flow of less than three percent. Surface and subsurface drainage are routed first to the settling basin, which then drains to the lagoon. Four-inch perforated drain lines were placed on 25-foot centers at approximately three-foot depths on the west half of the loafing area. They combine into a main drain line that is routed to a five-foot-diameter culvert placed outside the lower end of the loafing area. Here flow is measured with a tipping bucket equipped with a magnetic sensor that sends a signal to a datalogger (CR-10) with each tip.

A central slot takes a subsample of flow to a small reservoir that is pumped by an ISCO sampler at times based on flow. Samples are stored in an automated refrigerated sampler until retrieval for analysis. Surface flow is routed by berms to a three-inch parshall flume where the height of rise in the forward section of the flume correlates to flow (Q). This sonar will allow measurement of height in the flume to 45 cm with an error of <2 mm over a temperature range of 5 to 40°C. This results in a relative error in flow of less than 3 percent. At the outlet of the flume, a two-inch PVC pipe has been installed that routes water at low flow periods to a tipping bucket for increased precision of measurement when flow in the flume is at heights below that which has a good correlation to Q.

Project area

Waste management

Project duration

March 1994-Dec.1996

Budget:

SARE	
ACE	$68,613
Matching	$26,540

For subsurface flow, the two halves of the loafing area are separated by a gravel trench that diverts flow from the non-tile drained side away from the tile drains. At the time of establishment approximately 240 background soil samples were taken incrementally to two meters to determine initial soil inorganic and organic N levels. Soluble P and labile P in runoff will be compared to extractable P of surface soil samples and P adsorption capacity of the surface soil to determine any relationships. Soil samples have been extracted and are in the process of being analyzed. The area was soil sampled at 20 locations in increments of 0-3", 3-6, 6-12, 12-24, 24-36, 36-48, 48-60, 60-72, 72-84, 84-96, and 96 + inches for initial content of total N, ammonium, nitrate, and phosphorus.

The Region III office of the EPA has tentatively agreed to provide $32,000 in additional funding to install a second system on another farm. The second site, the Allen Bridges Dairy in Oglethorpe County, has been selected and is currently being planned by NRCS engineers. An initial EM survey was completed on September 27, 1995. Readings indicate very low conductivity in the area to be used.

The $32,000 available through EPA 319 funds in an agreement with the Georgia Soil and Water Commission and the Broad River Soil and Water Conservation District will be used to build and monitor this site. Construction will be similar to the loafing lot at the Walker Dairy with an improved area of approximately 8,000 ft^2 placed adjacent to the feed barn. The entire area will have tile drains to capture subsurface flow and route it to a tipping bucket for measurement and sampling. Surface flow will be routed to an adjacent lagoon and measured with a parshall flume.

Construction is tentatively scheduled for December 1995. Soil samples will be taken after construction to characterize initial soil N and P levels. An initial EM survey of this site was performed in November 1995.

In the remaining four months of the project, all soil samples from site one will be analyzed and samples will be taken from the second proposed site. An updated EM survey will be conducted near the project end. An important goal of the remaining months is to initiate the long-term monitoring effort. Additional funding agencies are being contacted as to their willingness to support the extended (multi-year) monitoring program that will be required to monitor the usefulness of the underdrained loafing lots.

The target audience for this project is limited-resource dairymen (herds of less than 200 cows) in the region. Information dissemination will be very rapid through the Little River/Rooty Creek Hydrologic Unit Area Project.

Results form the project will be published in the Extension newsletter as they become available. A field day was held in August 1995 to demonstrate the system and discuss results. The results will also be presented at a biannual Georgia Water Resources Conference and published in the proceedings of that conference. Finally, the results will be published in several refereed journal articles in the agricultural engineering and soil science fields.

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AS94-13
LS94-59
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Assessing the Impact of Beneficial Insect Populations on Organic Farms

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Biological control, which results from activities of natural enemies (parasites, predators and pathogens) that attack pest insects, is perhaps the most important form of environmental resistance operating to suppress pest populations. Organic farmers must rely heavily on biological control to suppress their pest populations and many release predaceous and parasitic insects, purchased commercially to augment the biological control that occurs naturally. Despite the heavy reliance of organic vegetable farmers on biological control, the occurrence of insect parasites and predators on pest populations in organic tomato production in the Southern Region has not been documented. In the absence of information on: which natural enemy species are present, when they are present, which pests they attack and their impact on pest populations, it is impossible for farmers to take full advantage of biological control to protect their crops. This research project was undertaken to provide this information and had as its objectives:

Objectives

1.) Identify species of natural enemies present in organically grown tomatoes.

2.) Characterize the seasonal patterns of abundance for important natural enemy species.

3.) Identify the important prey or host species for these natural enemies.

4.) Document the impact of naturally occurring biological control on populations of key pest species.

5.) Measure the impact of releases of commercially purchased lacewings and *Trichogramma*.

Approach

These objectives were addressed by sampling populations of insect pests and their natural enemies weekly in commercial plantings of organically grown tomatoes on four farms in North Carolina. To quantify the impact of biological control on aphids, the growth of potato aphid populations caged to exclude parasites and predators was compared with that of comparable aphid populations at the same location that were exposed to natural enemies.

In addition, to quantify the level of parasitism and predation on tomato fruitworm eggs, a constant number of "sentinel" egg clusters were placed in each field on a weekly basis through the season and the extent to which they were parasitized or preyed on was recorded. All parasites and predators were collected for identification. The impact of releasing purchased *Trichogramma* egg parasites on the level of parasitism of tomato fruitworm eggs was also measured on two occasions using sentinel egg clusters.

Results

The findings during the first year of this project demonstrate that biological control by naturally occurring insect parasitoids and predators was very important in the suppression of insect pest populations in organic tomato production. In particular, egg parasitism of both hornworm eggs by *Trichogramma spp.* and *Telenomus sphingis*, and also of fruitworm eggs by *Trichogramma spp.* was generally high and at times approached 100 percent.

These high levels egg parasitism, in combination with egg predation, primarily by green lacewing larvae and lady beetles, appeared to play a crucial role in making organic tomato production an economically viable enterprise. Larval parasitism was less significant, not only because it was lower and highly variable, but also because it did not prevent the larvae from damaging the plants and fruit.

Results suggest that the naturally high levels of egg parasitism make the benefits of releasing purchased *Trichogramma* for control of hornworms and tomato fruitworm unpredictable, unless the releases coincide with periods when natural parasitism is low. To maximize the benefits of such releases, farmers will require a knowledge of the how parasitism levels change over the season. Additional data on this point will be gathered during the 1996 season.

Naturally occurring biological control of aphid populations was also shown to be important in suppressing aphid populations, but its importance varied locally within fields. Both plant condition and rainfall seemed to be major factors in the decline of aphid populations.

These results suggest that one or more well-timed releases of aphid predators (e.g. green lacewings) could prove valuable in preventing the development of damaging aphid populations in organic tomato plantings. The potential of this approach will be investigated further during 1996.

An additional year of data will be required to

Project area

Beneficial insects

Project duration

March 1994-Dec.1996

Budget:

SARE	$17,735
ACE	$37,207
Matching	$14,068

validate the findings presented in this report. Once that is done, the results will provide organic farmers with information required to determine the value of releasing purchased parasitoids and predators to control tomato fruitworm, hornworms and aphids. The results will also provide the first thorough documentation of the impact of naturally occurring biological control in organic tomato production in the Southern Region. As such, it will help to identify the level of biological control that can be obtained when conventional production practices are modified to accommodate the important biological control agents.

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AS94-14
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Forage, Biomass and Biogas Integrated Systems for Animal Waste Management

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Alternative outlets for animal waste disposal and recycling must be developed to reduce the waste stream and result in sustainable use of nutrients. This project is studying an integrated biomass and biogas energy production system as a tool for managing animal wastes.

Objectives

1.) Determine nutrient removal from the waste stream via energy production and nutrient fate when land applied to switchgrass.

2.) Determine total energy production from an integrated biogas-biomass system.

3.) Examine the economics of the system and components including environmental impacts.

Approach

A large bioreactor on a cooperating dairy farm has been successfully renovated and will begin generating methane from dairy manure for on-farm energy use in 1996. Large plots of switchgrass were instrumented at the Texas A&M University Agricultural Research and Extension Center at Stephenville and dairy waste was applied to the plots to determine nutrient removal in biomass, residual nutrients in the soil, movement of nitrate-nitrogen in soil water and nutrients in surface runoff water.

Results

During 1995, no significant movement of nitrate-nitrogen was detected in soil water under switchgrass, nor were there significant elevations of nutrients in the runoff water from manure-treated plots. In fact, quality of runoff water from untreated portions of the plots used as vegetative filter strips for manure-treated areas was improved.

The amounts of fibrous solids generated on three dairy farms by the use of different types of manure solids separators are also being measured. These fibrous solids have value as a biofuels feedstock, animal bedding, compost, and, if properly treated, an improved animal feed. Production of solids has ranged from 250 cubic feet per day to 1950 cubic feet per day depending on the dairy size, time of the year and separation method. Samples of the screened solids and switchgrass biomass will be treated via ammonia fiber explosion (AFEX) to enhance the value for feed and fuel.

Thus, the most important findings from the first year of data collection is that using switchgrass for land application of dairy wastes can prevent leaching of nitrate-nitrogen, and, if used as a vegetative filter strip, can reduce concentrations of pollutants in surface runoff water.

Project area

Integrated systems

Project duration

March 1994-Dec. 1997

Budget:

SARE	
ACE	$101,180
Matching	$157,894

SARE/ACE
Sustainable Agriculture Research and Education
Agriculture in Concert with the Environment
Southern Region

AS94-15
Final Report
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Integrating Grazing Systems Planning and Decision Support for Improved Sustainability and Environmental Quality

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Project area

Integrated systems

Project duration

March1994-Dec. 1995

Budget:

SARE	
ACE	$27,500
Matching	$67,115

The overall goal of this project was to assess grazing strategies that improve profitability and sustainability while reducing environmental pollution resulting from grazing systems. The goal for this specific one-year planning grant was to develop a research and Extension plan, coordinated among several institutions in the Southern region with input from beef producers, which would attain the overall goal.

Objectives

1.) Formulate (and build on existing) multidisciplinary teams to develop a research and education plan for assessing sustainability (from both an enterprise and farm-level profitability and environmental quality aspect) of grazing strategies.

2.) Plan for development of a research/Extension project and select a site where the project team could apply selected strategies for integrated resource management (IRM) of a grazing system for beef grazing, including monitoring/verification of the profitability and water quality impacts of the selected systems.

3.) Plan for comparison of the IRM systems to a conventionally managed grazing system (i.e. only one field) for both profitability and environmental impact on the proposed intensively monitored site.

4.) Plan for later Extension of the project results to additional demonstration sites and to other producers through workshops and training opportunities. Present the advantages of IRM for grazing systems as documented in the project for both profitability and environmental quality.

Approach

The following specific procedural steps were followed:

1.) Identified a working group of 32 people to coordinate development of the proposal representing different states, disciplines, areas of expertise and interests from within the Southern Region.

2.) Assembled the group at the University of Kentucky in Lexington in June1994 to discuss goals and objectives for the project development.

3.) Assigned sub-group responsibilities of coordination of three aspects of the proposal development: a) grazing system research and modeling, b) hydrologic research and modeling and c) dissemination and application of results.

4.) Conducted preliminary analyses to aid in project planning using the GRAZE model for determining pollutant loading rates from cattle and selected field scale models to analyze potential stream pollution of a particular farm system. Undergraduate students were employed to make preliminary model analyses.

5.) Re-convened representatives of the group a second time as a smaller working group to discuss the results of the analyses, and to finalize the project goals and objectives.

6.) Prepared the final consensus draft for submission to SARE/ACE, with input from all institutions involved and from the producers involved.

Results

During the grant period, the major project objectives were accomplished as follows:

A 32-person team was assembled for developing the coordinated project proposal, and the group came to a consensus as to the goals for the proposed three-year project "Integrated Grazing Systems Decision Support for Sustainability." A four-track project approach was formulated that would have attained the goals of the group for developing a sustainable grazing system planning tool and the supporting research information. The project proposal was developed and submitted to SARE/ACE for funding. This planning grant was instrumental in beginning/reinforcing the dialogue between diverse groups interested in improved grazing system management for water quality in riparian zones in the Southern region.

An EPA 319 grant was funded to the UK College of Agriculture in cooperation with the NRCS and Kentucky Division of water to identify and coordinate nine producer sites for demonstrating and testing the ideas discussed by the project team regarding riparian zone grazing management. Several members of the project group are also associated with this project, which was just recently initiated. This project includes no decision support tool development, but will aid in providing the needed data for extrapolation of research and demonstration of BMP concepts to other sites. However, only limited data acquisition support

was available for this project, due to funding constraints.

Comparisons were made between continuous and rotational grazing systems using the GRAZE computer model. Results demonstrated the economic advantages to producers for rotational grazing systems as compared to continuous grazing. This supports the BMP for riparian zone management of use of rotational grazing management. The principles of the EPIC model were identified as applicable for implementation with the GRAZE model for decision support. However, graduate student support will be needed to implement the union of these two models to accomplish the objectives of the planning grant.

Information regarding controlled/rotational grazing and its potential impact on water quality improvement was disseminated at field days, Extension meetings and through the popular press and media.

This one-year planning grant enabled the diversified group described in this report to be formed, and allowed for the development of a full proposal to SARE/ACE. Although the information on grazing system impact on water quality in riparian zone farms will be obtained over a longer time frame since the full project was not funded, the linkages formed by this planning project should prove to hasten that process. An EPA 319 grant that was funded has enabled some of the work to proceed at a limited level.

A second proposal has been submitted to SARE/ACE for collecting the much-needed data on cooperating producer farms. Also, a proposal for development of the decision support system is being formulated for submission to the USDA NRI by another sub-group of the project team. If funded, these projects should help to attain the goals of the original grant.

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AS94-16
Annual Report
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Development of Guidelines for and Demonstration of Efficient Treatment of Swine Lagoon Wastewater by Constructed Wetlands

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Project area
Waste management

Project duration
March 1994-Dec. 1997

Budget:
SARE $130,325
ACE
Matching $78,553

Swine waste management practices are under scrutiny because of their potential impact on the environment. Many swine production facilities employ liquid waste management systems with lagoons as temporary waste storage structures. Odors and the potential for water contamination are frequently cited as problems of such operations. Depending on the capacity of the lagoons, the liquid waste must be periodically land spread to accommodate the waste and to avoid overflow of the lagoons. Odors are particularly evident during land application of lagoon-stored swine waste. Alternative swine waste management systems are needed which can reduce the impact of the waste on the environment and which can reduce the conflict between swine producers and home owners who reside near swine operations.

Constructed wetlands have been acclaimed in recent years as a new liquid waste management strategy that can reduce the impact of the waste on the environment and reduce odors associated with land spreading of the waste. The use of constructed wetlands for wastewater treatment was introduced in Europe and Scandinavia as an effective and affordable alternative to conventional municipal waste treatment systems. However, the use of constructed wetlands for treatment of livestock waste is a relatively new use of the technology. A project was initiated in Alabama to demonstrate successful treatment of and to develop guidelines for treatment of swine lagoon wastewater by constructed wetlands.

Objectives

1.) Evaluate and demonstrate the bioremediation potential of constructed wetlands operated at three wastewater loading rates for efficient treatment of swine lagoon wastewater and to develop best management practices (BMP) for use of constructed wetlands with input from swine producers and other project cooperators.

2.) Monitor deep wells and lysimeters installed in and around the wetlands site to measure the impact of the wetlands on groundwater quality.

3.) Demonstrate best management practices for efficient operation of constructed wetlands to livestock producers and regulatory agencies through on-site field day programs and with input from project cooperators, prepare a handbook as an operational guide.

Approach

The wetland treatment system used in this project was constructed at the Sand Mountain Agricultural Experiment Station at Crossville, Alabama in the late fall of 1988, according to design criteria from the Tennessee Valley Authority. The system consists of two tiers of wetland cells, five cells in the upper tier and five cells in the lower tier. Each of the cells is 0.1 acre (26 feet wide x 164 feet long). Each cell was planted with emergent aquatic plants in the spring of 1989. The four major plantings were broadleaf and narrowleaf cattail, soft-stem bulrush and common reed. Swine manure from a 500 pig/year farrow to finish operation is hydraulically flushed from the swine facilities to a primary anaerobic lagoon which flows to a secondary lagoon. Wastewater from the secondary lagoon is mixed with fresh pond water to reduce the ammonia-nitrogen (NH3-N) concentration of the lagoon effluent which is then distributed to each of the cells in the upper tier of wetland cells.

To achieve Objective 1, each of three of the wetland cells in the upper tier were loaded with nutrients at three different rates (88.9, 59.4 and 29.6 lbs biological oxygen demand (BOD)/acre/day) to determine the effect of the loading rates on the treatment efficiency and sustainability of the wetlands.

The nutrient loading rates were based on the suggested loading rates for municipal wastewaters but data indicates that these loading rates are too high for swine lagoon effluent. The nutrients in swine waste are considerably more concentrated than in municipal wastes. Concentrations of NH3-N in swine lagoon water have been reported as high as 400 mg/L and concentrations of NH3-N approaching 100 mg/L can be toxic to some types of wetland plants. Therefore, alternative loading rates used in the study were 9.8, 4.1 and 2.0 lbs (BOD)/acre/day.

Results have indicated that the treatment efficiency of the wetlands increased when the BOD

loading rate was reduced from 9.8 to 4.1 lbs BOD/acre/day, but did not improve when the rate was further reduced to 2.0 lbs BOD/acre/day. At the 4.1 lbs BOD/acre/day loading rate, the mean concentrations (mg/L) of nutrients in the water after wetland treatment were: total Kjeldahl nitrogen (TKN) 6, ammonia-nitrogen (NH3-N) 3, nitrate-nitrogen (NO3-N) < 1, biological oxygen demand (BOD) 9, total phosphorus (TP) 23 and total suspended solids (TSS) 10.

The treated wastewater from efficiently operated constructed wetlands, according to the Natural Resource Conservation Service, should not exceed the following water quality criteria (mg/L): NH3-N 10, BOD 30 and TSS 30. The 4.1 lbs BOD/acre/day loading rate achieved these criteria and the 9.8 lbs BOD/acre/day loading rate met all the criteria except for NH3-N.

The study has demonstrated that high treatment efficiencies can be achieved at low BOD loading rates. However, higher loading rates that can be sustained without impairment to the wastewater treatment efficiency of the wetlands are necessary to make wetlands practical for treatment of nutrient rich wastewater from livestock operations.

In the coming year the BOD loading rates to the system will be increased to evaluate higher loading rates that provide efficient wastewater treatment and also maintain sustainability of the aquatic plants and the wetland system. This information will be used to develop operational criteria and a handbook which provides information to swine producers how to successfully operate a constructed wetland treatment system.

In Objective 2, four deep wells drilled to permanent groundwater and positioned around the wetland system and eight soil-water lysimeters drilled directly in the wetland cells at depths of two and four feet were monitored on a quarterly basis to determine any movement of nutrients into the groundwater. Nitrate-N can migrate easily into groundwater and is commonly used as an indicator of contamination. None of the deep wells contained NO3-N in excess of the potable water standard (10 mg/L).

In addition, bacterial levels (fecal coliforms and fecal *Streptococcus*) used as indicators of groundwater quality revealed no evidence of groundwater contamination. Water samples collected quarterly from lysimeters positioned in the wetlands showed no evidence that NH3-N, NO3-N and TP had leached into the wetland soil profile. These data demonstrate that constructed wetlands treating livestock wastewater can be operated without adverse effects on groundwater.

Objective 3 of this project will be the culmination of Objectives 1 and 2. Data from this study and input from swine producers, state and federal agency personnel and scientists will be assimilated into a handbook containing design and best management practices for constructed wetlands treating livestock wastewaters.

Results

Milestones of the project to date are:

1.) The wastewater treatment efficiency of the wetlands has been successfully sustained for nearly five years without impairment to the aquatic plants in the wetlands.

2.) Wastewater treatment efficiency of the wetlands meets criteria suggested by the Natural Resource Conservation Service

3.) Groundwater from lysimeters located in the wetlands and water from wells positioned around the wetlands show no evidence of groundwater contamination from the wetland wastewater treatment system.

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Transitioning to Sustainable Methods in Sugarcane Farming

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Sugarcane farming in Louisiana presently uses methods of intense aerial application of pesticides during the growing season and burning of leaves surrounding the stalk at harvest time.

Objectives

This project provided for designing and building equipment that would accomplish the following:

1.) Eliminate or reduce aerial application of pesticides in sugarcane production.

2.) Reduce the volume of pesticide application and combat pests (sugarcane borer) more effectively.

3.) Reduce drift and overspray which has contributed to human health problems, fish kills and wildlife damage.

4.) Decrease capital input of sugarcane farming and make the operation more sustainable while farmers look for alternatives to diversify their operations.

5.) Improve air quality especially during harvest time when burning sugarcane is prevalent in a 22-parish area.

6.) Provide a mulch for stubble cane fields where sugarcane has been cut and stalks have been removed, thus preventing runoff and providing winter protection to new shoots.

7.) Provide improved pesticide safety for applicators.

Approach

The completed design consists of a six-wheel, skid steering, 53HP power unit. It has a sealed air-conditioned cab with a special filtering system, which protects the operator from chemical drift at all times. A radar sensored computer allows pinpoint accuracy in applying pesticides so that only what is needed is applied.

The sprayer is mounted on a Hy Cycle trailer pulled by the power unit. Double tandem flotation tires distribute the weight to the side of the rows where the soil drains and dries quickly rather than in the bottom of the furrow where the soil stays soggy. The spray loom can be operated in a range from three to eleven feet off the ground. It sprays eight six-foot cane rows in one pass.

A third component in the works will use suction fans to remove dry leaves from sugarcane stalks and turn them into mulch, eliminating the need to burn off the leaves (farmers are penalized if leaves are not removed from stalks before the cane arrives at the mill for processing). The mulch will reduce soil runoff, protect the new shoots and prevent weed growth.

Results

The power unit and sprayer were demonstrated at two parish field days, where they generated much interest among other sugarcane farmers. The demonstrations also generated feature stories in the *Daily Iberian* and the Southern SAWG newsletter *Southern Sustainable Farming*.

Project area

Reduced inputs

Project duration

March 1994-Dec. 1995

Budget:

SARE	
ACE	$15,000
Matching	[1] $6,000

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Biological Control Methods for Citrus Rust Mites and Spider Mites on Florida Citrus Utilizing Predaceous Arthropods as Part of IPM

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Citrus is a multi-billion dollar agricultural business in Florida that annually provides 70-80 percent of the total United States production. About $70 million is spent annually by farmers in Florida for chemical control of mites on citrus. Alternate control strategies of mites on citrus must be developed. Reduction of our dependence on chemical control of mites is critical for agriculture. Use of native and exotic arthropod predators (especially predaceous mites) is one proven way of regulating phytophagous pest mite population.

Adequate survey and identification of various predaceous arthropods on Florida citrus have not been completed in over 20 years (Muma 1975). This information is vital for planning alternative control strategies for mites.

We need to understand the potential importance of ground clover plants within and around citrus groves. We need to identify whether vertical movement of predators may occur and, if so, when. If we are to manipulate selected predators, it will be necessary to know their food preferences, consumption rates, and distribution within citrus groves.

We must understand which of the pesticides currently used by citrus growers are having the greatest disruption on the beneficial complex. Also, we must identify which of the pesticides are minimally disruptive to selected predators. Continued use of selective pesticides may provide control of targeted arthropod pests while having minimal impact on phytophagous mite pests and their predators.

Finally, evaluation of different control strategies based on our findings in the first four objectives will strengthen our ability to develop effective, alternative ways to suppress targeted species of phytophagous pest mites on Florida citrus. Results of this research will reduce Florida citrus growers reliance on the use of pesticides for control of the citrus rust mite and spider mites. Reduction of one or more pesticide applications, reduction of potential ground water contamination, reduced costs for growers, reduced risks of direct contact exposure to farmers, or indirect exposure to consumers by pesticide residues on or within fruit, providing growers with specific profitable and sustainable farming methods while satisfying human food and fiber needs, conservation of natural resources, fish, and wildlife habitat are a few of the potential benefits of this research.

Objectives

1.) Determine the seasonal occurrence and distribution of *Agistemus floridanus* (Acari: Stigmaeidae) and other predaceous arthropods within individual trees in seven selected commercial citrus grove sites located in central and south Florida for one year.

2.) Identify important weed (ground cover and vine) plants within the citrus groves that contain *A. floridanus* or other prevalent species of predaceous arthropods during the year. Determine when specific ground cover plants are flowering within each selected grove site. Determine if there is seasonal or vertical movement of predaceous mites or insects between citrus and ground cover vegetation or vines within the groves.

3.) Determine the life table parameters of *A. floridanus* and other selected prevalent predators including developmental rates, reproductive potentials, and number of female progeny produced per adult female in the laboratory when provided with citrus rust mite as the food source.

4.) Determine comparative toxicities of all registered pesticides (including insecticides, miticides, fungicides and herbicides) used in the Florida citrus industry at recommended and reduced field rates against *A. floridanus* populations and one or more other selected prevalent species of predaceous mites or insects based on results from Objective 1.

5.) Establish experimental citrus grove sites with other farmers previously on chemical mite control programs and implement augmentative infestations of selected predaceous arthropod species and ground cover plants (if appropriate) and modify spray programs to minimize toxicity to the selected predators. Continued monitoring of these sites will be completed during years 2 and 3 of the project to establish successful biological control of the targeted mite species and fine tune the methods.

Project area

IPM

Project duration

March 1995-Dec. 1998

Budget:

SARE	$75,000
ACE	$50,512
Matching	$87,000

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AS95-20
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Utilization of Natural Enemies, Viral Insecticides and Improved Information Delivery for Management of Lepidopterous Pests Developing in Transgenic B.t. Cotton

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Insect management on conventionally-produced cotton in the Southeast still depends on repeated applications of synthetic chemical insecticides even though the "Boll Weevil Eradication Program" (BWEP) has resulted in reductions of these applications. Research in South Carolina has demonstrated that early-season applications for control of tobacco budworm (*Heliothis virescens*) to protect initial fruiting structures are not generally needed because of plant compensation. Also, research has quantified that natural enemies of insects increase substantially in early season in the absence of these applications. With the advent of transgenic *B.t.* cotton and its integration into grower production systems, we will be afforded even greater opportunities for substantial reductions in "hard" pesticides for insect control.

B.t. cotton is essentially a genetically different crop, particularly in relation to insect management. Current information indicates that it will virtually eliminate *H. virescens* as an economic pest; control of the cotton bollworm (*Helicoverpa zea*) is good except under very high pressure; and some suppression of soybean looper (*Pseudoplusia includens*) occurs. However, fall armyworm (*Spodoptera frugiperda*) and beet armyworm (*S. exigua*) are not controlled and can cause extensive damage in *B.t.* cotton in the Southeast. Because viruses have demonstrated effectiveness against these pests on conventional cotton in the past, and since populations of natural enemies have been severely reduced by synthetic chemical insecticides, a strong effort is needed to determine and utilize their combined effectiveness in *B.t.* cotton production systems.

Objectives

1.) To quantify and assess impact of insect pests and their natural enemies in transgenic *B.t.* cotton compared with conventionally managed cotton.

2.) To determine efficacy of and develop viral microbial insecticides against lepidopterous pests developing in transgenic *B.t.* cotton.

3.) To develop delivery methods for the integration of *B.t.* cotton and viral insecticides into grower-driven crop production systems.

Approach

Currently, Bollgard (transgenic *B.t.*) cotton is being planted by the following growers: Don McDaniels with 10 acres near Bishopville, Phil Sandifer with five acres near Denmark and Youmans Brothers Farms with 10 acres near Estill. These large, unreplicated acreages will be monitored by consultants and Clemson personnel and will not be sprayed for pest insects.

Also, 1/10 acres replicated plots have been planted on the McDaniel and Sandifer Farms and on the Pee Dee (Florence) and Edisto (Blackville) Research and Education Centers for use by a Ph.D. student to determine thresholds for stink bugs in *B.t.* cotton. These plots/plantings will be the foci for the study to utilize viral insecticides with increased natural enemies on *B.t.* cotton to manage major lepidopterous pests without the need for "hard" insecticides.

Project area
Pest management

Project duration
March 1995-Dec. 1996

Budget:

SARE	
ACE	$37,820
Matching	$46,759

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Reduced-Risk Cockroach Control in Confined Animal Production

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Central to the philosophy of integrated pest management (IPM) is the idea that treatment should be based on need. Yet, current cockroach suppression practices in both urban environments and swine production rely heavily upon multiple scheduled applications of broad-spectrum insecticides with little concern about pest population size. This is primarily due to lack of efficient detection and monitoring tools for cockroaches. Therefore, a major motivation of this project is to study the utility of cockroach pheromones in the implementation of IPM principles in managing cockroaches. The goal is the isolation, identification and synthesis of the sex pheromone of the Oriental cockroach.

Laboratory and field studies will evaluate the utility of these compounds for integrated cockroach management in swine houses. Integration of the sex pheromone with reduced-risk insecticide bait formulations, insect growth regulators and biological control agents will also be studied. Each component of the resulting reduced-risk pest suppression program will be demonstrated on a commercial farm. Reference and training materials (manuals, interactive computer, videos) on reduced-risk pest control techniques will be developed and made available to target audiences, including commercial producers (confined livestock and poultry) and county Extension personnel.

It is anticipated that the long-term impacts of this project will include the following: Pheromones will reduce insecticide use, increase accessibility to pests that retreat into insecticide-free cracks and crevices, increase the efficacy of insecticides, serve as highly specific agents with negligible mammalian toxicity, permit the viability of reduced-risk biopesticide approaches such as biological control agents, reduce costs and will have a direct impact on the quality of worker health, the environment and swine production.

Objectives

1.) Identify the volatile sex pheromone of the Oriental cockroach and integrate it with other biopesticides (e.g., repellents, biological control agents, insect growth regulators) to effect reductions in pest populations.

2.) Demonstrate each component of the reduced-risk pest suppression program on a commercial farm, develop reference and training materials (manuals, interactive computer, videos) on reduced-risk pest control techniques and make these available to target audiences, including commercial producers (confined livestock and poultry) and county Extension personnel.

Approach

A three-pronged approach will be used to document and demonstrate reduced-risk pest control approaches in confined animal production systems.

1.) Laboratory and field research will result in the synthesis of pheromones that are needed for the development of better pest management practices.

2.) Laboratory and field studies will evaluate the utility of these compounds for integrated cockroach management in swine production.

3.) In cooperation with a swine research facility and a commercial producer, participants will demonstrate the efficacy of this program and quantify reduction in human health and environmental risks.

Project area

Pest management

Project duration

March 1995-Dec. 1996

Budget:

SARE	
ACE	$38,840
Matching	$15,889

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AS95-22
Annual Report
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Biological Control of Silverleaf Whitefly in Floriculture

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Bill's Greenhouses

The goal of this study is to demonstrate the effectiveness of biological control agents in managing insect pests of greenhouse crops. The project will develop critical data on the utility of three biological control agents against two insect pests of poinsettias and establish an educational base for Extension specialists and growers on the integration of biological control in greenhouse IPM. It will reduce pesticide inputs in these systems, thus, minimizing environmental impacts, improving worker and consumer safety, and retarding the rate of development of insecticide resistance.

Three agents—the entomogenous fungus *Paecilomyces fumosoroseus*, the entomogenous nematode *Steinernema feltiae*, and the predatory mite *Hypoaspis miles*—will be integrated with standard production practices to manage population of silverleaf whitefly, *Bemisia argentifolii*, and the darkwinged fungus gnat, *Bradysia coprophila*, on poinsettia, *Euphorbia pulcherrima*. *P. fumosoroseus* has been demonstrated to be an efficacious agent for whitefly control and both *S. feltiae* and *H. miles* have proven to be successful organisms against fungus gnats. While all three agents are commercially produced and marketed, they have not heretofore been integrated into a comprehensive crop production system as proposed here.

Objectives

1.) Develop application schedules for the entomogenous fungus Paecilomyces fumosoroseus (PFR) and fungicides commonly used in floriculture production while maintaining efficacy of PFR against whiteflies.

2.) Determine the efficacy of treating cuttings from whitefly-infested ornamental crops (i.e., poinsettia and verbena) with PFR during propagation and shipping to growers for subsequent crop production.

3.) Determine the efficacy of pre-production PFR-treated and conventionally treated cuttings in production programs utilizing PFR and conventional treatment against whiteflies in commercial ornamental production.

Approach

Determination of fungicide application schedules that are compatible with the use of PFR will be completed in the laboratories and research greenhouses on the Georgia Experiment Station campus of the University of Georgia at Griffin by Dr. Harris. Procedures were outlined and described in the original proposal. Poinsettia plants and whitefly infestations have already been established for this component of the proposed project.

The determination of the effects of treating cuttings of ornamental plants with PFR during propagation and shipping will be initiated by Dr. Osborne at the University of Florida Research and Education Center, Apopka, FL. Unrooted and rooted cuttings treated with PFR will be shipped to Dr. Harris and cooperating growers in Georgia for assessment of the effects of the treatment during shipping.

These PFR-treated cuttings will then be subjected to commercial production practices both at the Georgia Experiment Station and at the commercial cooperators, Camp and Company Farms and Bill's Greenhouses. In addition, groups of unrooted and rooted cuttings that were not treated with PFR will be shipped to Dr. Harris and the grower cooperators to serve as controls.

Unrooted and rooted cuttings that were treated with PFR and subsequently shipped to Georgia will each be divided into two groups: one group to continue to receive PFR treatments to control whiteflies and a second group to continue to receive PFR treatments for whitefly control. The cuttings not treated with PFR prior to shipping will likewise be separated into the two groups to serve as controls.

The commercial cooperators will include these cuttings in all normal production practices with the exception of the cuttings which will continue to receive PFR for whitefly control. Those cuttings will be treated with PFR by personnel from the Georgia Experiment Station. Necessary applications of fungicide will be made on these cuttings by the cooperators in accordance with the compatible schedules determined under the first objective.

Impact

Currently, whiteflies are controlled most commonly by the applications of insecticides. This project is designed to demonstrate the feasibility of using a biological control organism (PFR) as an alternative to these conventional chemical insecticides. Whitefly pests have shown tremendous capability to develop insecticide resistance. The

Project area

Biological control

Project duration

March 1995-Dec. 1996

Budget:

SARE	
ACE	$45,389
Matching	$11,250

use of an entomogenous fungus to control these pests will reduce insecticide use, thus slowing development of insecticide resistance, prolonging the useful efficacy of available conventional insecticides against these pests, and reducing chemical in puts in greenhouse production systems.

A thorough assessment of the economic impact of controlling whiteflies with PFR must include many considerations. Insecticide use reduction will not only save the cost of chemicals, especially nonefficacious ones that must be frequently reapplied to achieve acceptable control, but will reduce such costs as those associated with restrictions of runoff.

Of utmost importance, however, is the maintenance of efficacy of the few chemicals registered for use. PFR offers an alternative to chemical application, thus relieving the continual pressure to which the insects are subjected and which hastens the development of resistance.

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Increasing Acceptance of Low-Input Landscapes for the Southeast

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This project evaluates the relative costs and likelihood of adoption of several landscape management options.

Objectives

1.) Determine and demonstrate the aesthetic, economic and environmental costs and benefits associated with various pest management methods applied to typical southeastern landscape plants and the interaction with the cultural variable, shade.

2.) Determine the feasibility and impediments to acceptance and implementation of alternative pest management approaches in southeastern landscapes.

Approach

A split-split plot design involving 20 mini-landscapes constructed in the Georgia Station Research and Education Garden will be used to evaluate and demonstrate the relative costs and benefits of landscapes based on pest resistant plants and on common pest susceptible plant materials under traditional, alternative (scouting-based, targeted biological and biorational) and no intervention pest management programs. The cultural variable of shade vs. no shade will also be evaluated for potential influence on susceptibility to pests of landscape plant materials chosen for study.

Sampling at regular intervals will assess relative pest pressure and plant quality. An aesthetic, environmental and economic cost/benefit analysis will be applied to resultant data. Public acceptance of landscape services as demonstrated during field days will be assessed and will form the basis for targeted educational programs designed to modify public expectation of what constitutes responsible landscape maintenance service and quality landscapes. Therefore, we address a major impediment to the implementation of biologically based landscape pest management

This experiment, set up as a split-split plot design with five replicates, will use pest management strategies and shade as the main plots and the individual landscape beds as subplots. The design evaluates influence of traditional chemical management, targeted biorational pest management, resistant plant-based management and untreated controls.

Management plans will be imposed in cooperation with TruGreen ChemLawn Research and Development Division. TruGreen ChemLawn representatives will provide a full program of lawn and tree and shrub care, to be applied on a regular basis. Treatments for the traditional program will consist of seven applications per year timed for maximum effectiveness. The targeted treatment plan involves monitoring based decisions and use of biological and biorational materials as needed for pest suppression.

Resistant plant-based plots will receive a similar targeted pest management program as necessary; the difference being the alternative plant materials. A minimum distance of six feet will separate the landscape beds within a plot and the replicate plots to minimize interactions among the plots. Each plot will be about 1600 square feet with a 50 percent shade treatment randomly assigned to one half of each plot.

Sampling will include the visual and trap-catch (pit-fall and yellow sticky card) monitoring of both beneficial arthropods and landscape pests and ratings of plant damage due to pests. The problem pests found on each plant species under the mixed landscape conditions versus the homogenous herbaceous or woody beds will also be evaluated. Insect populations and plant damage will be monitored by nondestructive scouting weekly for four weeks after planting and monthly through the growing season.

Surveys of homeowner's response and willingness to pay for various management services as revealed by studies under Objective 1 will be conducted in place during regularly scheduled field days. These responses will provide a basis for future educational efforts to modify public acceptance of alternative management tactics.

Project area

Pest management

Project duration

March 1995-Dec. 1996

Budget:

SARE	
ACE	$36,826
Matching	$15,980

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Identifying Pesticides Most Compatible with Parasites of the Citrus Leafminer

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The citrus leafminer (CLM), *Phyllocnistis citrella*, has caused extensive damage in door yard trees, nurseries and groves since its introduction into the USA in 1993. The CLM reduces growth, decreases quality and can even kill citrus trees. The CLM is also a vector of citrus canker. IPM tactics will be employed to manage the CLM, including cultural, chemical and biological controls. Biological control by parasites already present in Florida may provide some suppression. A classical biological control project to import host-specific parasites of CLM is promising. Two parasites, *Agenisapis citricola* and *Cirrospilus quadristriatus* were collected in Australia, cleared through quarantine, reared and released into citrus groves throughout Florida. Preliminary results indicate *A. citricola* has established, overwintered and dispersed from release sites.

At present, pesticides registered for use against the (CLM) and other citrus pests are considered to be disruptive to effective biological control. Thus no pesticides can be used where the parasitoid *A.citricola* is being released. It is difficult to get growers to completely suspend all pesticide applications for more than a year, which is one of the conditions for *A. citricola* releases in groves. Without information about which products are least toxic to *A. citricola* an IPM program cannot be developed for nurseries, groves or door yard citrus.

Homeowners, as well as grove and nursery producers are seeking information about products that exert low toxicity to natural enemies of a variety of pests (aphids, mites, scales) as well as *A. citricola*. Some products such as neem, pepper oil and other nontraditional materials may be effective components of an IPM program in nurseries and door yards. If shown effective and nontoxic to *A. citricola*, use of such products would reduce the impact of toxic pesticides on humans and the environment.

Objectives

1.) Evaluate pesticides to determine which products are least toxic to a parasite, *Ageniaspis citricola*, imported for classical biological control of citrus leaf miner.

2.) Transmit results to homeowners, nursery producers and grove managers to encourage the use of least toxic materials to enhance biological control of the CLM and other pests.

Approach

Bioassays will be conducted to obtain data on toxicity of pesticides to *A. citricola*. The data will facilitate the establishment and efficacy of this parasite in a classical biological control program. The information obtained will be delivered to homeowners, nursery and grove managers, Cooperative Extension personnel and growers via demonstration plots, articles in newsletters, trade journal and peer-reviewed journals.

Project area
IPM

Project duration
March 1995-Dec. 1996

Budget:

SARE	
ACE	$33,125
Matching	$24,487

Extension Training Projects

In 1994, the SARE/ACE Program launched the Extension Training Program to develop understanding and increase the awareness of sustainable agriculture production systems to extension staff and other professionals who provide information to producers.

The Southern Region's first group of Extension Training Projects addressed topics as diverse as teaching skills for managing rangeland wisely in Texas to developing a sustainable dairy systems manual in Tennessee and beaming a satellite course about the basics of sustainable agriculture from the University of Florida to universities in South Carolina, Kentucky and Arkansas.

In this photo, Mickie Swisher and Ann Bockarie look at water from a critter's point of view as part of a biological assessment of water quality. Field participants learned to evaluate water quality by the number and diversity of organisms living in runoff from conventional farms as compared to water from organic farms (LST94-7).

Left: Tim Cross and Beck Bowling, both of the University of Tennessee, lead a discussion on the forage chapter of the Dairy Systems Training Manual. Farmers and rural leaders in Tennessee and Kentucky worked with university researchers to develop actual farm plans that include costs, returns and production requirements for combining all phases of the dairy farm into a systems approach to management (LST-94-4).

Below: The universe was their classroom when Clemson University Entomology Professor John Morse joined other educators in several states to conduct a training session by satellite. Here he demonstrates how to sample for aquatic insects as part of a water quality session (LST94-7) Photo by Jim Palmer.

Extension Training Project Summaries

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Project LST94-1
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Southern Region Sustainable Agriculture Training Consortium

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The Southern Region Sustainable Agriculture Training Consortium facilitates and coordinates sustainable agriculture training for Cooperative Extension workers and other agricultural professionals. The consortium includes a diverse mix of individuals and organizations interested in sustainable agriculture. The consortium consists of a large stakeholder group, a nine- to twelve-member executive leadership committee and a three- member project management team. The aim of the consortium is to develop and manage the regional training program through a participatory strategic planning process.

Objectives

1.) Develop and build consensus for a regional training agenda.

2.) Provide training needs, priorities and RFPs to the SARE/ACE program.

3.) Develop and deliver process skills training opportunities.

4.) Support regional training project leaders.

5.) Establish linkages with other regional and national training programs.

Approach and Results

The first accomplishment of the management team was to solicit nominations and establish an interim leadership committee. The committee was established in the winter of 1994. It contains members from most of the states in the region. It also represents a diverse array of interests in sustainable agriculture: farmers, land grant institutions and government agencies, several non-governmental organizations, gender, ethnic background, geographic region, and personal interests and occupations. The leadership committee established a mechanism to perpetuate itself through a rotation process to bring on new people as existing terms expire.

Second, the management team has worked with the leadership committee to develop a consensus about the approaches the consortium will employ to coordinate and facilitate training. At the first face-to-face meeting, a process management expert was employed as a facilitator. During this session a mutual understanding was reached regarding the roles of the consortium, the expectations of the individual members of the leadership committee and contributions that the leadership committee and management team would make to the process.

As a result of this first meeting, including preparatory telephone conferences, the leadership committee developed a process and training priorities to serve as the bases for the RFP for the second cycle of training projects. In addition, the group developed a strategy to providing training implementation funds to each institution in the region to further the work initiated in the state strategic planning process. Both of these strategies were submitted to the regional Administrative Council and approved. Subsequently, RFP's were developed for both competitive training projects and implementation work plans. These proposals have been received and are in the review process at the present time.

A third major outcome of the consortium is the planning for the regional workshop. The program has been developed by the leadership committee and promotional materials have been disseminated for the workshop to be held January 18-19, 1995, in Lexington, KY. The workshop will emphasize the following three focus areas developed by the leadership committee: partnerships for sustainability; enhancing training capacities; and showcasing successful sustainable agriculture programs. The workshop is targeting state coordinators and state teams who are leading training efforts at the state level. Contacts in the states have been asked to assemble teams to participate in the workshop with the same degree of diversity that we have attempted to establish in the consortium leadership committee.

Finally, the management team has sought to create and build linkages to the ANR program leaders, Southern SAWG and Directors through special mailings and providing reports at annual meetings and other functions. One of the key linkages has been to state coordinators with whom the consortium team met in February 1995 at the SAAS meetings. A second meeting is planned for February 1996.

In 1995, Jim Lukens initiated a regular newsletter to state coordinators entitled *Chapter 3 Bulletin*. In addition, as the consortium team interacts with the states on implementing training plans, it is making contacts through the coordinators. Similarly, it has developed contacts with the other re-

Project area

Training

Project duration

March 1994-Dec. 1996

Budget:

SARE	$ 199,620
ACE	
Matching	$14,875

gional training project leaders, especially as it relates to evaluation strategies for competitive training projects. Finally, the management team has drafted a plan for documenting individual training that can be used uniformly in all regions.

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Environmentally and Economically Sustainable Use of Rangeland

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County Extension agents are generally well qualified for their jobs, and usually come from strong agricultural backgrounds. However, most receive college degrees in animal science and agricultural education disciplines. Therefore, many have little or no formal training in the area of rangeland management and may be unprepared to effectively help producers within their counties. *The Environmentally & Economically Sustainable Use of Rangelands* project was established to provide training and education for county Extension agents in rangeland management. This was accomplished through a series of three workshops conducted in one year.

Objectives

The objectives of this project were to provide course participants with the skills necessary to be able to understand and develop ecologically and economically sustainable range management practices affecting livestock and wildlife enterprises on the ranch. Specifically:

1.) Train agency personnel in setting goals and objectives and in learning techniques to assist ranchers in systematically developing alternative strategies to meet their goals and objectives.

2.) Implement the elements of the strategies for sustainable rangeland management.

3.) Evaluate the training and implementation project for further development into a sustainable rangeland management program to be made available to ranchers nationally and internationally.

Approach

The first session of the three workshops was held on July 18-20, 1995, at the Krooked River Ranch, near Haskell, Texas. This session was attended by 19 county agents from five Extension districts across the state of Texas. Each agent was required to attend all three sessions in order to complete the workshop series. The material covered during the three days of the first session consisted of learning the importance of 1) setting goals and objectives for ranch management planning and 2) economic and biological planning skills which are used to assess and monitor ranch and range conditions.

Instructors included Peggy Sechrist, president of Holistic Resource Management (HRM) of Texas, Dr. Larry White, Extension Range Specialist with the Texas Agricultural Extension Service, and Dr. Lorraine Zinn, an adult education specialist of Lifelong Learning Options in Boulder, CO.

The second session was held on October 10-12, 1995, at the Krooked River Ranch, near Haskell, Texas. This session discussed how:

1.) Range inventory and monitoring techniques are utilized to set and adjust stocking rates,

2.) Habitat requirements for different wildlife species and how range management practices and livestock grazing can influence habitat diversity and populations.

3) Prescribed burning can be utilized to support and promote sustainable grazing systems.

Instructors included J. F. Cadenhead and Richard R. Riddle of the Texas Agricultural Extension Service in Vernon, TX, Dr. Dale Rollins, Extension Wildlife Management Specialist from San Angelo, TX, Dan Caudle and Reggie Quiett of the Natural Resources Conservation Service (USDA-NRCS), Craig Winters, Wildlife Manager for the Nail Ranch in Albany, TX, Drs. Jim Ansley, Bill Pinchak and Richard Teague of the Texas Agricultural Experiment Station in Vernon, TX, and Dr. Lorraine Zinn of Lifelong Learning Options in Boulder, CO.

The third workshop session will be held on March 19-21, 1996. This session will emphasize the integration of grazing management systems with prescribed fire as a major tool in the manipulation of brush and noxious weeds. Tentative plans call for holding the session at the Waggoner Ranch, near Vernon, Texas. Agents will examine different grazing systems, construct a fire plan, and conduct an actual prescribed burn on rangelands.

During the first two sessions, Dr. Zinn served as an instructor as well as a critic of the program. Dr. Zinn taught several sections dealing with adult education and demonstrated to the participants how they may utilize the information gained from the workshop sessions to better serve the producers within their own counties. Dr. Zinn was also instrumental in helping to set up an evaluation form for both sessions. These evaluations were used to determine how the agents

Project area
Training

Project duration
March 1994-Dec. 1996

Budget:

SARE	$ 72,570
ACE	
Matching	$ 72,570

felt about various sections of the workshops, as well as the program as a whole. Dr. Zinn summarized the evaluations and made suggestions as the coordinators planned future sessions and workshops.

Results

The evaluations determined that the agents responded much more favorably to hands-on learning experiences, as opposed lecture-style work sessions. Therefore, as they planned the second and third sessions, more field exercises, ranch visits, and real life type problems were added to the schedule. This produced a very positive response from all participants involved .

The project coordinators anticipate that the evaluations will provide a measure of how successfully the agents were taught to incorporate what they learned into action plans for transferring this knowledge and technology to their producers.

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Management Intensive Grazing: Foundation of Sustainable Agriculture in the South

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Project area
Training

Project duration
July 1994-Dec. 1996

Budget:

SARE	$ 63,461
ACE	
Matching	$ 109,463

Objectives

The objectives of this project are to provide comprehensive management intensive grazing (MIG) to national Cooperative Extension Service (NCES), Natural Resource Conservation Service (NRCS) personnel, and innovative livestock producers stationed in the humid, temperate and subtropical Gulf South through a training project. Specifically:

1.) Demonstrate via lectures and hands-on field training the economic, environmental and agricultural benefits of MIG relative to conventional agriculture.

2.) Illustrate the role of MIG in comprehensive sustainable agriculture planning,

3.) Train participants to assess farm suitability (soils, pastures, building, equipment) for MIG,

4.) Train participants how to teach field management to other farmers,

5.) Develop and distribute training videos that will supplement participant knowledge,

6.) Develop and distribute fact sheets on MIG in the South for use by participants and clientele.

Methods

Workshops were conducted in April, May and September 1995 to train participants in management intensive grazing. Participants included producers and Natural Resource Conservation Service personnel from Louisiana, Arkansas, Mississippi, Texas, Georgia and Alabama with one Cooperative Extension Service agent from Kentucky and one from Louisiana. The workshops were conducted for three days with both classroom and field sessions.

The itinerary included as oral presentations in the classroom:

*The science and art of grazing management
*Environmental management
*Plant growth basics: energy flows, nutrient cycling, fundamentals of growth
*Understanding soils and the landscape
*Resources of the farm
*Economics of management intensive grazing
*Forage quality, animal requirements and intake
*Meeting nutritional needs of livestock
*Matching livestock and forage resources
*Forage system strategies for year-round nutrition.
*Controlled rotational grazing: putting it all together
*MIG on my farm
*Grazing Land Applications and nutrition balance

Field demonstrations with hands-on experiences included:

*Participant groups grazing demonstration
*Biodiversity
*Water systems
*Keeping pasture records
*Forage quality
*Field pasture assessment
*Forage harvest efficiency
*Fencing equipment
*Forages for year-round grazing
*Soils in the field
*Quantity measurement and species identification

Fact sheets have been written and included in a notebook for each participant with titles:

**The role of ruminant animals in sustainable agriculture*
**The forage growth and its relationship to grazing management*
**Understanding soils and landscapes*
**Estimating forage yield*
**Grazing dynamics of beef cattle*
**Proper grazing use*
**Fringe benefits of rotational grazing*
**Economics of management intensive grazing*

Results

Participants have been surveyed to determine constraints against establishing intensive grazing management. Personal management expertise of livestock and forages are always listed as the first constraints followed by fencing systems and operating capital with soil fertility, water availability, and livestock working facilities being less important. Producers indicate the consideration of implementing MIG is the result of a need for improvement in sustainability. This list shows these changes include increasing

utilization of existing forage, livestock numbers (carrying capacity), grazing efficiency, economics of livestock operation, milk production, animal control while decreasing labor and input costs and the amount of field work.

Technical personnel have listed priority areas for training in MIG as:

1.) Knowledge of intensive management systems in general,

2.) Fencing, water and shade requirements,

3.) Forage species selection and management, and

4.) Bridging the summer production slump.

The technical personnel attending these workshops have indicated that they were not able to adequately answer producers questions concerning intensive grazing. All participants were asked if their perception of the importance of the topics listed as constraints had changed during the course of the workshop. The five most important constraints had these responses:

	Percentage of respondents	
	Increased perception	unchanged
1. Forage management	72	16
2. Water availability	62.5	25
3. Manure management	53	28
4. Environ. quality issues	50	41
5. Operating capital	37.5	44

Responses by participants indicated an increased need for training in Management Intensive Grazing with increased involvement by Extension and NRCS personnel with producers who are participating in sustainable agriculture programs.

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Sustainable Dairy Systems Manual and Training

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Dairy farming is a significant and dramatically changing part of agriculture. This change is occurring in production systems, investment requirements, environmental concerns and the need for enhanced overall business management. Extension services in Tennessee and Kentucky are cooperating in preparing, pilot teaching and evaluating an interdisciplinary dairy systems costs, returns and production requirements manual and computerized data base. Farmers, agricultural organizations and rural leaders in Tennessee and Kentucky are actively involved in the development, evaluation and use of the training materials. The SARE/ACE program has invested in this project to enhance the sustainability of dairy farms.

Objectives

1.) Prepare, pilot teach and evaluate a dairy systems manual and computerized whole farm planning data base for the Southern region.

2.) Develop and prepare teaching materials on technical production relationships and costs and returns for appropriate crop and livestock enterprises including facilities, machinery investment and labor requirements for alternative technologies.

3.) Train Extension agents in Kentucky and Tennessee to use and teach from the manual and conduct educational programs with at least 500 farm families with dairies.

4.) Use the systems manual and computerized data base to develop intensive farm and financial plans with at least 110 Kentucky and Tennessee farm families.

5.) Use the dairy systems manual to teach SCS and ASCS personnel, agricultural lenders and other professional agricultural workers, environmental groups and rural people about sustainable dairy systems.

6.) Use the dairy systems manual to demonstrate to others the importance of a systems approach to management.

Approach

Over a two-year period, a 23-member work team of agronomists, economists, Extension agents, engineers, and dairy specialists, along with farmer advisors from Kentucky and Tennessee, are preparing, pilot teaching, and evaluating a dairy systems manual and computerized data base. The project started in August 1994. The fifth draft of the manual is being developed for testing purposes. The manual is scheduled to be finalized in June 1996. Systems are being developed for dairy herd sizes ranging from 50 to 800 cow operations. The systems approach is being used directly in developing actual farm plans with Tennessee and Kentucky dairy farm families.

The approved systems manual proposal originally included a total of five chapters on forage systems, feeding systems, manure management systems, milking centers, and a chapter combining all phases of the dairy farm into a systems approach to management. Environmental and sustainability concerns are being incorporated into the systems process.

As the project progressed, the work team added seven additional chapters. These new additional chapters address management information and decision support, dairy farmstead planning, dry cow housing, feeding and management, replacement heifer housing, feeding and management, milking herd feeding and housing facilities, and additional costs.

Extension agents in Tennessee and Kentucky have been trained to use the manual in conducting educational programs with at least 500 Tennessee and Kentucky farm families with dairy operations. Additional intensive training is scheduled to be conducted in March 1996. Their evaluations and recommendations will be incorporated into the final manual for distribution to other parts of the country.

Educational materials developed in this project are a critical component in an overall farm and financial management educational program. Properly combining the expertise of appropriate subject matter specialists, researchers, and farmers to identify interrelationships and results of various decisions will dramatically affect the future of dairy farm families.

The dairy systems program has demonstrated to others the importance of a systems approach to management. This should encourage leaders in other commodity areas to consider using this approach. Lessons learned and portions of the teaching material developed in the dairy systems manual will be use-

Project area

Training

Project duration

March 1994-Dec. 1996

Budget:

SARE	$90,000
ACE	
Matching	$277,920

ful in future work directed at other types of farms.

A major benefit of this program is the professional growth experienced by the twenty-three member team of economists, engineers, agronomists, animal scientists, agents, and area specialists. Working together as a team in putting together a total interactive system has improved the ability of each "specialist" to look at the often-complex total picture instead of focusing only on a small part of the issue.

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Sustainable Cotton Production for the South

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Winter legumes (annual clovers and vetch) have been used for over 100 years as a source of nitrogen (N) for non-leguminous cash crops (e.g. cotton and corn). Alabama's "Old Rotation" experiment (circa 1896) is the world's oldest, continuous cotton experiment and third oldest continuous field crop experiment in the U.S. on the same site. When it was started in 1896, its primary purpose was to determine the effect of crop rotations and winter legumes on sustainable production of cotton in the southern U.S. However, growers, for whatever reason, have been reluctant to adopt these well demonstrated, sustainable practices which protect the soil from winter erosion and add N to the soil. Perhaps inexpensive N fertilizers, traditional tillage practices and the nature of the growers winter legumes have made this practice unattractive.

Objectives

1.) Use the concepts of sustainability as illustrated in the 98-year Old Rotation to conduct on-farm sustainable cotton production demonstrations.

2.) Prepare research bulletins and popular brochures on the benefits of sustainability as demonstrated by 98 years of continuous, sustainable cotton production and on-farm demonstrations.

3.) Compute cotton sustainability and total social factor productivity indices in order to assess the ability of cotton to remain a viable economical and environmentally compatible crop for Alabama.

4.) Conduct workshops for county agents, providing training necessary to conduct on-farm sustainable production demonstrations.

Approach

Seven demonstrations were conducted on farmers' fields in 1994 and 1995, comparing new varieties of crimson clover and vetch as winter legumes with older, standard varieties as the sole source of N for the following year's cotton crop. The average N fixation over all tests in 1994 ranged from 75 pounds N per acre for the new A.U. Robin to 124 pounds N per acre for the old standby, hairy vetch. However, the A.U. Robin matures about two weeks earlier than the hairy vetch, making it much more sustainable for growing as a winter cover crop. The standard N fertilizer recommendation for cotton is 90 pounds per acre.

Results

Results from the Old Rotation and limited yield data from these on-farm tests (1995 was a disaster for cotton in Alabama) indicate that legume N is just as effective as fertilizer N for non-irrigated cotton production in Alabama.

In addition, the winter legume protects the soil from winter erosion, increases soil organic matter over the long-term and contributes to long-term sustainability of continuous cotton production. One cooperating grower claimed that using winter legumes (clover and/or hairy vetch) resulted in a net profit of $10 to $15 per acre over the use of fertilizer N.

In a separate analysis of long-term data from the Old Rotation, it was found that measured sustainability of continuous cotton production as a "total factor productivity" index is about the same for cotton produced using winter legumes and for only fertilizer N. Both these systems are more productive and result in less degradation of the resource base than a low input, no-N system.

Project area
Training

Project duration
March 1994-Dec. 1996

Budget:

SARE	$ 10,000
ACE	
Matching	$ 11,898

SARE/ACE
Sustainable Agriculture Research and Education
Agriculture in Concert with the Environment
Southern Region

LST94-6
Annual Report
December 1995

Extending Sustainable Agriculture Concepts and Practices to Traditional Agriculture Advisors

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To some in traditional agriculture, sustainable agriculture connotes organic farming, farming without chemicals, or more simply, "going back and farming like my grandfather." Even though there is some truth in all of the above, sustainable agriculture as it is practiced on many farms encompasses much more. This project's main purpose was to expose those who are in the agricultural mainstream as farm advisors (e.g. county agents and other government agency personnel) to ideas and concepts which may be somewhat foreign, or at least unconventional, when compared to those associated with traditional agriculture.

Objectives

1.) Expose Cooperative Extension Service personnel as well as personnel from other agencies such as SCS, ASCS and Land Resources Commission (henceforth referred to as the target audience) to concepts of sustainable agriculture from farmers who are successfully practicing unconventional methods of crop and livestock production.

2.) Expose the target audience to concepts and philosophies of environmentalists and others who feel they have a vested interest in seeing changes in conventional agricultural practices and to engage these groups in meaningful dialogue on these concepts and philosophies.

3.) Create a greater appreciation on the part of the target audience for concepts and philosophies of those advocating change in the conventional agricultural practices of today.

Approach

Two training sessions involving farm tours were conducted. One, in the Piedmont area of South Carolina in February 1995, featured an antibiotic-free beef operation, organic herb farm, conventional u-pick strawberry operation, conventional dairy farm with some unique ideas about waste management and energy conservation and a CSA (community supported agriculture operation). Fifty-two people attended, including 33 county Extension and specialists representing both Clemson and South Carolina State universities. Also, representatives from the South Carolina Department of Natural Resources, USDA-NRCS and the South Carolina Farm Bureau Federation, as well as five farmers, were in attendance.

The other tour was centered in the Pee Dee area of South Carolina in early August. Farms featured, for the same type of audience (57 attended) as in February, were a worm/compost farm, organic tobacco and soybean farm, a colored cotton operation, a conventional vegetable production and canning operation and a conventional row-crop farm using extensive IPM practices.

In addition to the farm tours, other sit-down presentations were made on each date on topics such as organic certification standards, update on sustainable agriculture strategic planning, sustainable agriculture at NCSU and various farmer panels in which first-hand sustainable farm experiences were related.

Results

There was an overwhelming positive response to the two training session conducted. Evaluations were summarized and participants indicated that they gained much from the presentations, interactions with the participating farmers, as well as with each other. Many felt they had been enlightened about sustainable agriculture and its many facets. Others related how what they learned would impact their future activities. And finally, most everyone gave this type of training high marks and hoped that there would be additional similar sessions in the near future.

Project area
Training

Project duration
March 1994-Dec. 1996

Budget:

SARE	$11,700
ACE	
Matching	$10,500

SARE/ACE
Sustainable Agriculture Research and Education
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Final Report
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Evaluating Sustainability: Gaining Insights

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The Southern Regional Training Workshop, Evaluating Sustainability, was a collaborative effort of six institutions: the University of Arkansas at Pine Bluff, Auburn University, Clemson University, the University of Florida, the University of Kentucky, and South Carolina State University.

Objectives

The workshop had four main objectives:

1.) Provide participants with an understanding of the multi-faceted nature of sustainability.

2.) Permit participants to use a variety of tools and approaches to evaluate the sustainability of agricultural production systems.

3.) Give participants an opportunity to apply a range of tools in classroom case studies and on-farm studies to determine the utility of these tools in the participants' own work situations.

4.) Permit participants to exchange experiences and share information with each other.

Approach

Five modules were included in the workshop:

1.) Biodiversity;
2.) Conserving Soil Resources;
3.) Money Matters;
4.) Energy, the hidden input;
5.) Water Quality.

The workshop was designed to bring together a diverse audience and provide an opportunity for the participants to explore their differences and agreements about the goals of sustainability, how we can move toward more sustainable agroecosystems, and how we might progress toward sustainability. The learning/teaching philosophy was based on participatory adult learning.

Acting on the call of many in the sustainable agriculture movement, the course moved beyond both philosophical discussions of "the meaning of sustainability" and beyond "how to" or "recipe" approaches designed to address specific production problems. Rather, it provided a framework for people from diverse walks of life, including environmentalists, farmers, Extension personnel, elected officials, teachers, and others to come together to agree, disagree, and move toward consensus on goals for the sustainability of agriculture.

A hands-on learning approach was emphasized. Many different activities were included during the two and one-half day workshop. These included:

1.) Videos with an interactive component.
2.) Background reading materials.
3.) Classroom exercises.
4.) Small or local group discussions.
5.) Field studies.
6.) Teleconference large group discussions.

This mix of activities was designed to accommodate the many different learning styles of adults and to help participants "close the learning cycle" by moving from affective learning to application to abstract concepts to on-the-job applications.

Results from the pre- and post-tests of knowledge and attitudes and from the process evaluations conducted at the workshop sites indicate that this learning approach was successful. The primary objective of the pre-post test of knowledge and skills was to determine whether participants learned new skills, gained new knowledge or changed their attitudes about sustainability as a result of the workshop. Analysis of test results show that in four of five modules there is a 95 percent probability that learning objectives were met. The same is true for the workshop as a whole. Conserving Soil Resources is the exception. In this case, the probability is only 86 percent that learning objectives were met.

Results from the process evaluations of the workshop are similar. Participants were asked how well each of the four workshop objectives described above were met. They responded on a scale of one (not at all) to four (completely). All participants indicated that workshops objectives were met to some degree.

Lower satisfaction was apparent for objective 2 (tools for evaluating sustainability), where 19 percent indicated that they met this objective only somewhat (score of 2).

Overall, however, almost all participants ranked satisfaction as "3" or "4". For example, 62 and 72 percent, ranked their satisfaction with objectives one (nature of sustainability) and three (classroom and field use of tools) as "almost entirely met" (score of 3). Almost all, 72 percent, indicated a score of four (completely) for objective four (participant exchange).

The cooperators are currently in the process of conducting follow-up evaluations of changed behavior on the part of participants.

Project area
Training

Project duration
March 1994-Dec. 1996

Budget:

SARE	$56,269
ACE	
Matching	$13,467

Producer Projects

The Producer Grants program was started in 1993 in order to capture on-farm producer experience and enrich overall SARE/ACE programming. Producer Grants are research or education projects that are developed, coordinated or conducted by producers (farmer/rancher) or producer organizations.

The Andy Hickox family grows corn, soybeans, tobacco and vegetables so close to the Okefenokee Swamp that bears occasionally raid the corn patch. Since Brantley County is in the Coastal Nutrient Management Zone, poultry producers who account for almost one million layers there face tighter restrictions.

Andy's project addressed nutrient management of poultry manure hauled from a neighbor's layer operation to his fields. The results will help Andy and other farmers determine the correct application rates and methods for fertilizing their crops while maintaining soil and water quality.

Young relatives came to help the Hickox family load cured tobacco for market on a summer morning. From left, standing: Cousin Toni Davis, Patricia and Andy Hickox. On top of the wagon from left: Cousin Kurt Hickox and Kelly Hickox (PG94-4). Photo by Gwen Roland

Top: Insect traps keep Extension entomologist Joe Lewis and cotton farmer Benny Johnston apprised of the beneficial insect populations after winter cover crops and conservation tillage improved habitat for them in Johnston's fields. The outcome of the test fields will determine how much of Johnston's 900 acres of cotton will convert to a more sustainable system (PG94-6). Photo by Gwen Roland.

Middle: "Raising Cane 200 years:1795-1995" is more than just a bumper sticker for the Judice family of New Iberia, Louisiana. It could be their family history in one sentence.

With ACE funding, farmer Jackie Judice has designed equipment to make sugarcane farming safer for future generations of his family. Jackie's son Chad is shown here with the Hy-Cycle sprayer which minimizes aerial pesticide spraying, reduces insecticide input by as much as 50 percent and boosts insecticide effectiveness. Later in the season the sprayer is replaced by another unit that strips the leaves off the cane stalks and turns them into mulch on the spot, thus eliminating noxious burning that has been the plague of sugarcane harvests (AS94-17). Photo by Rochelle Judice.

Bottom: Can clover clippings totally replace poultry manure in compost to meet the fertilizer needs of a commercial organic farm? Jean Mills and Carol Eichelberger are testing that possibility at their Tuscaloosa CSA in Alabama, where other farmers as well as CSA members get a firsthand look at the research during a field day. Photo by Wanda Pickering (PG94-11).

Producer Project Summaries

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Southern Region

PG94-1
Final Report
December1995

Controlling Aphids with Harmonia Lady Beetle in Pecan Orchards

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Yellow pecan aphids are an annual and nearly universal insect pest of pecans for which no sustainable control exists. A number of foliar applied insecticides are registered for yellow aphids, but control is poor and the insects often resurge after insecticides are applied. The soil-applied systemic insecticide Temik is registered and effective but is expensive ($45 and up per acre), can leach into ground water and may produce tolerance in yellow aphids after several years use.

A species of lady beetle, *Harmonia axyridis*, was imported from Japan and released in Georgia from 1979-81 by USDA entomologists. It has proved to be an excellent predator of aphids that attack trees and ornamentals, especially yellow aphids in pecans. Although the Harmonia lady beetle is now common in Georgia, Florida and some areas of Louisiana, it did not become widespread until 11 years after its release. A few individuals of this species had been found in Texas, and producers were looking for ways to increase Harmonia populations faster in hopes of providing more effective aphid control in pecan groves.

Objectives

1.) Increase the biological control of yellow pecan aphids in Texas by introducing the Harmonia lady beetle to pecan groves throughout the state.

2.) Increase producer awareness and knowledge of the Harmonia lady beetle and other beneficial insects and inform producers of their use in a biologically intensive IPM program.

3.) Develop and distribute an Extension bulletin outlining the use of the Harmonia beetle in a biologically intensive IPM program.

4.) Distribute a questionnaire to growers involved in the Harmonia release program to determine the level of beetle establishment and if they reduce levels of yellow aphids.

Approach

Twelve thousand beetles were collected from congregating sites on walls of buildings in sheltered areas of Georgia. They were swept into one gallon ice cream cartons and transported to Texas where they were stored in refrigerators at the Texas A&M Research and Education Center in Dallas. Later they were shipped to cooperating pecan growers throughout Texas who volunteered their operations as nursery orchards. The orchards were selected on the criteria of location, grower interest, grower commitment to using the least toxic pesticides and grower willingness to plant legumes as cover crops. The beetles became established at eight of the nursery sites in the 1994 growing season. Since then, orchard scouting by cooperators and Extension entomologists have monitored beetle and aphid population densities.

Vetch or clover was planted in strips throughout test plots in the orchards to attract pea aphids as an early season food source for the beetles and other predators. Total plantings range from 0.5 acres of legumes up to 15 acres per orchard. Lady beetles normally multiply in these legumes in the spring and then move into pecan trees to feed on yellow aphids in early summer.

Results

In 1994, beetles became abundant in both release and non-release orchards by midsummer, apparently from populations in Louisiana. This natural increase made it unnecessary to assist in redistributing Harmonia from the test orchards.

In the spring of 1995, beetles were most abundant in small grains (wheat) and alfalfa. Aphids were abundant in both crops in February and March. Harmonia were uncommon in legumes planted in orchards or in pecan trees at this time. Harmonia did not increase in pecans midsummer as they did in 1994, even though pecan aphids became very abundant. Many pecan producers throughout the state observed that Harmonia were much less common in pecan trees in 1995 than in the fall of 1994. No explanation was found for this decline in numbers.

In conclusion, legumes seemed less attractive to Harmonia beetles in the spring than did wheat or alfalfa, which hosted large numbers of aphids. Harmonia emerged from overwintering in February or March. Possibly aphids were more common earlier in wheat and alfalfa relative to the legumes and as a result these crops were more attractive to Harmonia. Adding wheat to legume plantings may increase attractiveness to beetles in the spring. Wheat alone may be a more reliable host for aphids than legumes, but wheat does not have the benefit of providing nitrogen to subsequent crops. It is not

Project area

Biological control

Project duration

July 1994-Dec. 1995

Budget:

SARE	$4,600
ACE	
Matching	$4,500

known why Harmonia numbers did not increase midseason in 1995 when pecan aphids became abundant. No theories have been put forth for testing.

Outreach

Grower interest in beneficial insects has identified the need for a field guide to important beneficial insects in pecans. Education and outreach efforts are now concentrated around a publication to teach growers how to identify and use the Harmonia lady beetle and other beneficial insects in biological control.

The Texas Pecan Growers Association has contributed funds to help the project coordinators publish such a book co-authored by Louis Tedders, a world-recognized pecan entomologist, and Bill Ree, Extension entomologist for pecans in Texas. The 100-page book with 150 color photos is scheduled for publication early in 1997.

Presentations have been made at Extension pecan programs throughout the state and at the annual conference of the Texas Pecan Growers Association. Articles in *Pecan South* and other publications have kept growers informed about the project.

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PG94-4
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Nutrient Evaluation and On-Site Composting of Poultry Litter

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Impending regulations in the Coastal Nutrient Management Zone are making it necessary for poultry farmers to adopt more efficient waste management programs. Lack of information about the proper use of poultry manure is a constraint to poultry farmers who wish to apply it to their own land and to other farmers who would like to purchase it from the poultry producers. The information gap includes basic questions concerning rates and methods of application for different crops.

The project coordinator grows tobacco, soybeans and market vegetables near the environmentally sensitive Okefenokee National Park. The area is also home to an increasing number of poultry operations. The project is generating information that will enable farmers located near poultry operations to precisely apply chicken manure to their crops, thus providing poultry operations with an outlet for their litter while offering farmers a local source of fertilizer.

Objectives

1.) Establish a demonstration illustrating the effect of rate and application methods of poultry litter applied to corn, soybeans and/or tobacco.

2.) Utilize soil, plant tissue, manure and water tests to compare the effect of different poultry litter application rates and methods on crop and soil properties.

3.) Conduct a field day to demonstrate the use of poultry litter as a nutrient source in corn-soybean-tobacco production systems.

Approach

In 1994, a corn demonstration was established in nine plots using three treatments each of uncomposted chicken manure and commercial nitrogen. Each plot consisted of 16 rows that measured 36 inches by 75 feet. The treatments for poultry manure were none, one truck load per plot and two truck loads per plot applied prior to planting. The treatments for side-dressed fertilizer were none, 70lb. N/A, and 90lb. N/A.

One truckload of manure per acre produced slightly lower yields (43bu.) as compared to the yield produced by 70lb. of N fertilizer (51.8bu.). Two truckloads of manure per acre produced 76.3bu., which was higher as compared to the 63.4bu. produced by 90lb. of N fertilizer.

The results indicate that poultry manure can reduce the amount of N fertilizer without reducing yield. One truckload of manure plus 70lb. of N fertilizer produced 85.1bu. as compared to 85.3bu. from 90lb. of N fertilizer, indicating that in this circumstance 20lb. of N fertilizer per acre could be replaced with a truckload of chicken manure with no reduction in yield.

The highest yield (96.2bu.) came from the plot treated with two truckloads of manure plus 70lb. of N fertilizer per acre. Increasing the N fertilizer to 90lb. per acre plus two truckloads of manure resulted in lowering the yield to 87.9bu.

By testing manure, soil, plant tissues and local surface/ground water supplies, the investigators hope to track and record nutrient amounts and transfer throughout the 1996 growing season. The data will be used to help farmers determine the nutrient content of manure and the best application rate and method for a particular crop.

Outreach

A field day was held in September, 1995 with eight farmers and three Extension agents attending. An Extension corn specialist and soil specialist conducted a tour of the plots and presented written and oral explanations of the results.

Project area
Nutrient management

Project duration
July 1994-Dec. 1996

Budget:

SARE	$ 3,000
ACE	
Matching	$2, 275

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PG94-5
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Vegetable Marketing Strategies for a Small Farm Co-op

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In order to succeed, farmers who belong to market co-ops must learn to supply produce year-round. They must also learn to apply techniques and strategies to market that produce. Such techniques and strategies include proper preparation, storage, packing and shipping.

Objectives

1.) Conduct a series of vegetable marketing workshops focusing on readying, transporting and marketing produce to commercial markets.

2.) Evaluate current marketing strategies to determine strengths and weaknesses.

3.) Develop an evaluation/assessment plan to determine the effectiveness of workshops and seminars.

4.) Submit annual reports concerning farmers' attitudes and income gains after applying various marketing strategies and techniques.

5.) Host an annual demonstration marketing field day to include other farmers in the area and other cooperatives.

Approach

During this three-year project, leaders are arranging with commercial vendors and agricultural service representatives to provide a co-op of 55 small farms with a series of workshops that focus on techniques for timely production and on preparing, transporting and marketing produce in a more profitable manner.

The first year began with a workshop called *Sharing Information About My Farm*, which led co-op farmers to examine the ways they were currently marketing their produce and to note the strengths and weaknesses of those methods. This was followed by workshops entitled *Problems Facing Farmers Today* and *Financial Management Training*. The latter included sessions in computer training for farm management and presentations about sustainable agriculture.

A form is being designed and will be mailed to participants for their evaluation of the effectiveness of the workshops. Future seminars will build on the strengths of the current strategies to develop a progressive marketing program.

Results

Participants report that the workshops have fostered a positive attitude, and they are eager to learn new ways of marketing their produce. They are consulting more with each other about individual crops and about striving for consistent quality in the produce coming from co-op farms.

The computer workshop was particularly popular and has spurred requests for more training in farm record keeping by computer. The co-op is investigating the possibility of purchasing computers for this training.

Results were demonstrated on November 17, 1995 when the farmers put into practice the skills they had learned in the workshops. They pooled produce of consistent quality from their various farms and then loaded trucks to send their first shipment from South Carolina to Baltimore, Maryland.

Co-op members anticipate that the changes will impact profits, but at this time it is still too early to tell.

Outreach

A total of 40 people attended the 1995 workshops.

In October, the first marketing field day was attended by 19 people, including farmers from other communities. It was held at the Joseph Fields farm, which produces squash, strawberries, collards, cabbage and broccoli. The group was given a tour of the farm, which uses a combination of bed and row planting techniques. The pond and irrigation system were included in the tour.

Joseph Fields concentrated on squash for the marketing demonstration. He explained how to grade for color and size. After harvesting, the squash was placed in a dilute wash water containing dish detergent and chlorine bleach. The bleach acted as a cleansing agent and the detergent imparted a shine. The squash was then placed in crates, ready to be transported. He explained that the squash blossoms are sometimes sold as a specialty item.

The field day concluded with a meal at the Fields' home, where attendees discussed their own operations and exchanged ideas.

Project area

Marketing

Project duration

July 1994-Dec. 1997

Budget:

SARE	$10,000
ACE	
Matching	$1,850

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PG94-6
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Insect Pest Management for Cotton

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Project area
IPM

Project duration
July 1994-Dec. 1995

Budget
SARE $8,700
ACE
Matching $12,930

Cotton production has historically involved the use of large amounts of pesticides. The eradication of the boll weevil from the Carolinas, Georgia and Florida has provided an opportunity to move pest management on cotton to a more sustainable system. The other major cotton pests such as the bollworm, beet armyworm, thrips and aphids are attacked by a wide variety of natural enemies that with proper management can suppress these pests. These beneficial insects can be of major value to the economic success of cotton and to the transition to more sustainable agriculture.

Three primary approaches to conserving habitats and enhancing the populations of beneficial predators include: reduced tillage, habitat enhancement through refugia strips within the crops fields or around their margins and reduction of pesticide use.

Objectives

In this project, cotton producers working closely with USDA entomologists developed the following objectives for field trials on their farms.

1.) Identify and quantify the beneficial arthropods found in various conservation-tilled systems as compared to conventional agro-ecosystems.

2.) Evaluate the benefit of planting and maintaining beneficial-insect-enhancing plants, either in refugia strips within the field or as margins around the borders of the field.

3.) Quantify the biological and economic benefits of reduced pesticide use.

Approach

Pitfall traps were used in 1994 and 1995 to monitor and compare the seasonal abundance of ground-dwelling arthropods in cotton fields located in the Coastal Plains region of south-central Georgia. In 1994 traps were placed in a 50-acre conservation-tilled crimson clover/cotton field and in an adjacent 50-acre conventionally tilled field in Dooly County. In 1995, traps were also placed in a third field in Tift County planted with cotton and a series of six three-row, non-cultivated refugia strips. A second series of traps was placed in a perpendicular transect across the Tift County field to monitor density and dispersal of beneficial arthropods from the refugia strips into the cotton strips.

Commonly collected arthropods at all three study sites included two species of Collembola, *Bourletiella hortensis* (Sminthuridae) and *Podura aquatica* (Poduridae), the striped earwig *Labidura riparia*, the red imported fire ant, *Solenopsis invicta* and nearly 20 species of Carabid beetles. Several Staphylinid species and two Cicindelids, *Megacephala carolina* and *Cicindela nr. sexguttata*, were also common. Other abundant arthropods included spiders, primarily Wolf spiders (Pardosa) and Clubionids, and one species of centipede, *nr. Lithobius forficatus*.

Whole plant and sweep samples were also used in the same fields to monitor and compare the seasonal abundance of plant-dwelling beneficial and pest arthropods. Samples were also taken in a perpendicular transect across the Tift County field to monitor density and dispersal of beneficial arthropods from the refugia strips into the cotton strips.

Commonly collected pest arthropods at all three study sites included thrips, aphids, *Aphis gossypii*, the tarnished plant bug, *Lygus lineolaris* and four lepidopterous species, including the budworm, *Heliothis virescens*, bollworm, *Helicoverpa zea*, cabbage looper, *Trichoplusia ni* and soybean looper, *Pseudoplusia includens*.

Beneficials commonly collected included up to 15 species of spiders, the big-eyed bug, *Geocoris punctipes*, three species of ladybird beetles: *Coccinella septempunctata*, *Hippodamia convergens* and *Harmonia axyridis*, brown and green lacewings and the red imported fire ant, *Solenopsis invicta*.

All pest management decisions were made by independent consultants employed by the cooperators. Treatment decisions were based on established intervention guidelines.

Results

Early in the season, thrips populations were generally lower in the clover field than in the conventionally treated field. Later in the season, thrips populations were comparable for both fields, but failed to attain economic levels in either field. Tarnished plant bug populations were reduced in the clover field relative to the conventional field. Square retention counts in both fields remained over 90 percent; therefore, the cotton was not treated for plant bugs. Eggs of the budworm and the bollworm were less abundant in the clover field than in the conventionally tilled cotton, which was also reflected in the number of heliothine larvae present in the two

fields. Five insecticide treatments were required in the conventional field, four of them for boll worm/budworm controls, whereas only two treatments (one for bollworms and budworms) were necessary in the clover field.

In contrast to the researchers' observations for heliothine eggs, eggs of cabbage and soybean loopers were observed in higher numbers in the clover field than in the conventional field. The number of resultant larvae, however, was reversed, with more larvae occurring in the conventional cotton than in the conservation-tilled field. They contributed this difference in larval numbers to the increased activity of fire ants in the conservation-tilled fields. Although soybean looper populations became quite high, no insecticides were applied for control since loopers are considered a minor pest because they attack the foliage rather than the bolls.

Cutworms were rarely observed in either field. Aphid populations peaked earlier and attained higher levels in the clover field than in the conventional one. After these populations declined in both fields (due to the entomopathogenic fungus *Neozygites fresenii* and parasitoids and predators), aphids rebounded more rapidly and to higher levels in the clover field than in the conventional field. Again, the more rapid and extensive growth of aphid populations in the clover field can likely be attributed to the elevated activity of fire ants in the conventionally treated field.

The results indicate that the use of a leguminous cover crop, in conjunction with conservation tillage may provide considerable benefit for managing insect pests. It appears that one of the key components in the pest reductions observed in the clover field was the presence of fire ants. Their presence, however, may have been a function of reduced tillage rather than the use of a particular cover crop. Conventional tillage disrupts fire ant foraging and destroys ant mounds, whereas these disruptions are reduced in conservation-tillage systems.

In regions where the aphid-pathogenic fungus is present, the increased aphid populations occurring in conservation-tilled fields may present little difficulty. In other regions, however, the protected aphid populations may present serious challenges, including possible induction of secondary pests after treatments for aphid control.

Despite its apparent benefits, several agronomic problems were encountered with the crimson clover system. The cotton stand was reduced by nearly 20 percent in the clover field, resulting in a yield loss estimated to be 25 percent (final results are still being tabulated). In the coming season, the producers plan to make adjustments, such as increasing the seeding rates and the width of the tilled planting strips to improve stand and yield.

Outreach

Two field days were held in 1995. On July 12, the Georgia House of Representatives Agricultural Committee and other invited policy makers visited the field in Dooly County as part of their review of farm usage. On August 21, growers from Arkansas and other southern states stopped at the Dooly County field for exchange of information about advances in sustainable cotton production systems.

A full review of the project complete with results to date were published in the proceedings of the 1995 Beltwide Cotton Conference. Final results are currently in preparation and will be published in the 1996 Proceedings.

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PG94-7
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Perennial Warm Season Grasses as Summer Pasture

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Each year more dairy farmers are discovering the benefits of grazing their herds to reduce feed costs. However, the majority of forage crops in North Carolina are cool season, which creates a feed deficiency for grazing cattle during the summer months. If warm season perennial grasses could be added to the pasture forage, the grazing season would be extended, and the dairy farmer could realize more profit by spending less on feed.

The cooperators planted two warm season perennial grasses into a fescue pasture to see if the grazing season could be extended on their dairy.

Objectives

1.) Establish and evaluate cost-effectiveness of warm-season, perennial pastures for sustainable dairy production.

2.) Hold a field day to demonstrate the use of warm-season perennial grasses as a component of an intensive grazing system for dairies.

Approach

The project evaluated two warm season species, flaccidgrass and Eastern gammagrass, planted on seven acres of a dairy farm that has 80 cows. The grasses were to be evaluated both as forage and as the basis of a feed ration. Evaluation of the profitability was to be determined by comparing the feed costs and returns above feed costs over the past several years to the costs and returns above cost during the project year.

During the summer of 1993, the producers, working under the advisement of the North Carolina Cooperative Extension Service, the Natural Resource Conservation Service and North Carolina State University technicians, planted five acres of flaccidgrass and two acres of Eastern gammagrass on a fescue pasture that had been in use for more than 50 years.

The fescue sod was harvested for hay, and the stubble was sprayed with Roundup to kill the sod. Once the stubble was dead, a bush hog was used to cut it to about one inch or less. The residue was raked into windrows, baled and removed from the pasture. Seed was planted with a sod drill provided by NCSU. The calibration and seed depth was set by technicians from the university. Insecticides, herbicides and fertilizers were applied according to recommendations from the above agencies.

Results

The stand was a total failure.

After the failure of the warm season grasses, the producers sod-drilled rye grass for winter and early spring grazing on the seven acres. The rye grass performed as expected, providing grazing for the milking herd and, later, the bred heifers.

The producers tested the warm season perennials again in the summer of 1994. Following the same plan as the year before, they killed the fescue sod and removed the residue before drilling in the seed. Again they followed agency recommendations for establishing these grasses. The stand failed.

During the two planting seasons only one Eastern gammagrass plant grew; none of the other seeds germinated. Less than 10 percent of the flaccidgrass seeds germinated and survived. In both years there was adequate rainfall for grasses.

In the fall of 1994 they sod drilled Alfagraze into the seven acres. A stand was established, and in the summer of 1995 it produced four alfalfa harvests for hay or grazing.

The researchers are aware of a corn silage field that was successfully converted into warm season grasses, so the two years of failed stands makes them consider the possibility that fescue may be toxic to the grasses they were trying to establish.

Outreach

Several field days were planned to demonstrate the benefits of warm season forages and how they fit into a grazing scheme. The field days were conducted but the presentations focused on the producers' grazing program rather than the warm season grasses, since there were no benefits to report. The project field was used to illustrate that graziers may want to avoid trying to sod drill into old fescue stands.

Project area

Dairy forage

Project duration

July 1994-Dec. 1995

Budget:

SARE	$733
ACE	
Matching	$1,767

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PG94-8
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Meat Goats for Weed Control and Alternative Income on Cattle Operations

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The demand for goat meat exceeds supply in North Carolina and other East Coast states. In North Carolina a new slaughter facility has opened to supply domestic and export markets. With the continual influx of immigrants who prefer goat meat, the demand is expected to increase. While goats have been used for biological control of weeds, brush, multiflora rosa and kudzu on farms, there is a limited supply of meaty type animals available to producers.

The goal of this project was to find out what breed of goat would produce the most rapid growth and the heaviest carcass in the Southeast. Finding a meat goat that produces more per acre per year (because of more kids born) could potentially have a significant impact on income. Finding a breed which provides a higher dressing percentage will bring premium prices.

Objectives

1.) Evaluate and compare Tennessee Stiff Leg goats to existing goat herd in terms of meat production performance and compatibility with beef cattle.

2.) Maintain production records of animal breeding and gain performance, slaughter characteristics and price.

3.) Share production records and cooperate with NC State Cooperative Extension in disseminating information about meat goat production.

4.) Host a field day/tour to demonstrate the integration of meat goat production in beef cattle operations.

Approach

The research took place on a 130-acre cattle ranch that has traditionally used goats to improve pasture for cattle. The project compared the production performance of mixed breed goats to the production performance of mixed breed goats that have been interbred with pure Tennessee Stiff Leg goats known for heavy muscling and high kid counts. The Stiff Leg goats supposedly have two kid crops per year and average three kids/doe. Most meat type breeds kid only once per year, averaging 1.4 kids/doe.

The Hobbs Packing Company of North Carolina purchased all the kids and reported the dressing percentages for comparison purposes. Breeding records, gain performance, slaughter characteristics and price were also compared between the two herds.

Six herds of 16 does each were used in the study. For the purposes of this study the term *Spanish goat* refers to unregistered, high quality grade goats of the Spanish type. *Standard goats* in this study are unimproved strains of mixed-breed goats as found at local auctions. They are sometimes referred to as brush goats, native goats or junkyard goats, depending on locale. *Stiff Leg goat* refers to the purebred stock introduced to upgrade the Spanish and standard goats.

Of the six groups of does, two groups were Spanish, two groups were Stiff Leg and two groups were standard. One group in each breed category was bred to a Stiff Leg buck, with the other group in each breed category bred to a Spanish buck.

Results

In these on-farm trials there was no difference in compatibility with the beef cattle when the Tennessee Stiff Leg goats were compared to the producer's original herd of Spanish goats that were raised with the beef cattle. Both groups performed adequately in removing brush and weeds from overgrown land and turning it into pasture. However, the rancher noticed that the Stiff Leg goats were not as aggressive in foraging, and they were more prone to illness in bad weather as compared to the Spanish goats.

In meat production, the Stiff Leg crosses did not perform as well as the producer expected. In almost every category, they produced fewer kids as compared to the Spanish goats. The kids from Stiff Leg crosses had lower weights at birth, at weaning and at slaughter 30 days after weaning as compared to Spanish crosses.

The Stiff Leg goats did produce a slightly higher dressing percentage in some categories, but not enough to offset the fewer kids and the lower weights.

The greatest number of kids (36) came from Group A, which consisted of Spanish does and a Spanish buck from a line that had been selectively bred for multiple births and meaty build through several generations on the project coordinator's ranch. They represented the best of the project coordinator's breeding program. Does from that same line

Project area
Alternative crops

Project duration
July 1994-Dec. 1995

Budget:

SARE	$ 2,020
ACE	
Matching	$ 4,200

were used for Group E, but when bred to a Stiff Leg buck they produced only 20 kids that also averaged 1¼ pounds less at birth.

When bred to standard does, the Stiff Leg buck made a better showing (24 kids) but still did not equal the performance of the Spanish buck (23 kids) because at slaughter the Stiff Leg kids averaged four pounds lighter as compared to the Spanish kids.

The rancher conjectured that perhaps in a strict production management system, the Stiff Leg goats could produce two kid crops per year, but on his forage-only system they did not. He also noted that even Spanish goats will kid twice a year if they are in a strict production management system.

Although the duration of the project covered only one generation of Stiff Leg cross breeding, the rancher anticipates that future crosses building on that generation will produce the heavier kids that Stiff Leg goats are reputed to produce. However, since his own breeding program has produced a strain of goats prone to multiple births, he does not expect that the Stiff Leg breeding will increase the number of multiple births. Therefore in this farm trial the most improvement from the influence of Stiff Leg breeding was seen in the lower quality animals.

Outreach

The project coordinators spoke at the Southeast Regional Meat Goat Association Educational Meeting sponsored by the North Carolina Cooperative Extension Service and hosted a field tour attended by 117 people in conjunction with it. The rancher also spoke at a goat field day sponsored by Kentucky Cooperative Extension Service.

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Site Specific Applications of Seed, Fertilizer and Chemicals

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Although technology now exists to make site specific inputs of seed, fertilizers and chemicals feasible and profitable, field-wide or farm-wide applications are still the norm throughout the South and the rest of the United States. Research has shown that applying these inputs according to soil type and productivity will reduce costs, increase profitability and reduce environmental hazards.

Objectives

1.) Divide and map field areas by soil type.

2.) Obtain soil and plant samples in each mapping unit, and fertilize, plant and apply pesticides as indicated by test results in each mapping unit.

3.) Utilize global positioning systems technology and mapping to maintain site-specific cost, return and environmental records. Monitor water runoff on test areas.

4.) Compare economic, agronomic and environmental data from fields receiving site-specific management to adjoining fields using current practices.

Approach

This project is evaluating the use of site specific inputs on land that is being converted to a no-till operation. A 132-acre portion of a 2,000-acre family farm is being devoted to five crops (corn, grain sorghum, wheat, cotton and soybeans) for the duration of the two-year project. The results will be compared to an adjoining field that is being conventionally farmed to produce the same five crops. If the results indicate that no-till, site specific techniques are more feasible and profitable than conventional methods, the entire farm will be converted to the prescription farm process and technology.

In the no-till site specific field the following practices are being used:

1.) Map soils using the AgMapp computer program to show soil types in each crop area.

2.) Sample soils in each crop area.

3.) Fertilize, plant and apply chemicals according to crop and soil type needs.

4.) Gather yields by soil type at harvest.

In both fields the following is taking place:

1.) Monitor crop progress with infra-red photography

2.) Use global positioning systems (GPS) technology, computers and AgMapp system to ensure accuracy of all operations.

3.) Monitor water runoff for environmental impact.

4) Record cost and return data.

The first year of the project (1995) the maps were made under the direction of a soil consultant. On the maps the producer can see the soil types on each acre, plus keep a record of his seeding rates, all treatments and harvest data.

In 1995 plantings of corn and soybeans were ruined by excessive rainfall. The cotton was ruined by herbicide drift from a neighboring farm. The grain sorghum was affected by excessive heat and drought, making the summer season a major loss.

The wheat crop has been planted according to specifications from the soil maps. The spring crops will follow suit.

Outreach

The 1996 report will include economic analysis, problems and successes for each crop. The reports will be part of the education and outreach when they are sent to all Extension agents and SCS personnel in North Texas as well as to the major agricultural publications. The reports will be made available to all producers in North Texas and anyone else who is interested. Field days and tours will be conducted when the system is underway.

Project area

Cropping systems

Project duration

July 1994-Dec. 1996

Budget:

SARE	$10,000
ACE	
Matching	$20,900

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Clover Clippings as Replacement for Chicken Litter in Compost

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One of the elements of sustainable agriculture is reduction or elimination of off-farm inputs while maintaining soil productivity. A four-acre organic garden in Alabama has been enriching its soil with living mulches of clover and with compost which has depended on purchased chicken litter as the main nitrogen source. For a number of reasons the owners are questioning the sustainability of purchased chicken litter in the organic production system. The reasons include contamination risks, economic feasibility, transportation problems and other practical considerations. The growers speculated that they could mow the clover living mulch and use those nitrogen-rich clippings to replace the chicken litter in compost.

Objectives

1.) Compare clover clippings with poultry litter as a nitrogen source for compost in terms of handling, cost and quality of compost as a complete fertilizer for organic vegetable production.

2.) Determine the best carbon source for use in clover compost.

3.) Determine if the fertility needs of a vegetable garden can be met by mowing and composting the clippings from a living mulch of white dutch clover growing in 2½-foot strips between the three-foot vegetable beds.

4.) Host a field day to demonstrate clover composting to other growers and agriculturalists.

Approach

The project evaluates the use of clover clippings to replace chicken litter as the nitrogen source in compost. Normally the entire garden is planted with white dutch clover. At planting time it is tilled into the beds but left growing in the walkways where it protects the soil from erosion and compaction, retains moisture, provides habitat for beneficial insects, suppresses weeds and adds nitrogen and organic matter. The crops are fertilized with compost made from organic matter (including clover clippings) produced on the farm plus purchased chicken litter.

For project purposes comparable compost piles will be maintained for one year. Some compost piles will be made with chicken litter. The nitrogen source for the other compost piles will be clover clippings. The goal is to produce soil fertile enough to grow vegetables without the use of off-farm nitrogen.

The study began in spring of 1995 when the clover was mowed, collected and piled for composting. A total of seven compost piles were constructed: four using clover as the main nitrogen source and three using chicken litter:

Clover/hardwood sawdust
Clover/straw
Clover/pine sawdust
Chicken litter/hardwood sawdust
Chicken litter/pine sawdust
Chicken litter/dried grass clippings/vegetable waste/straw/other garden waste
Clover/dried grass clippings/vegetable waste/straw/other garden waste

The piles will overwinter under fabric covers. Tests will be conducted in spring 1996 to determine amounts of macro- and micronutrients as well as the biological components of the finished compost. In addition to comparing clover clippings to chicken litter in compost, the project aims to determine the best carbonaceous materials to use with clover.

Project investigators have identified several differences in the making of compost with clover versus chicken litter. From a cost standpoint, the chicken litter must be purchased, while the clover requires only the labor to mow it. For two compost piles of comparable initial size the costs were approximately $30 for a four-cubic-yard load of chicken litter as compared to $32 for four hours (at $8/hr.) of mowing clover. The project farm is located in an area where chicken litter is readily available; the price might vary in other communities.

The piles were built by one or two people on the ground with pitchforks and one person on a tractor equipped with a front-end loader. They discovered that the clover requires more pitchfork mixing than the chicken litter, which can largely be handled by the front-end loader. Subsequent turning of both piles is done with the front-end loader.

Making compost with clover clippings must be done within a limited time frame in early summer, which is already a very busy time for farmers. Once mowed the clippings quickly turn to slime if not combined with

Project area

Organic vegetable production

Project duration

July 1994-Dec. 1996

Budget:

SARE	$6,160
ACE	
Matching	$6,040

carbonaceous materials. The chicken litter may be stockpiled and used at a less busy time.

On this farm the clover provides beneficial habitat, protects the soil from erosion and compaction and suppresses weeds. To be able to harvest nitrogen by mowing the clover is considered a bonus by the participants, especially since the clover requires occasional mowing anyway. For them the benefits of clover outweigh the slight advantage that the chicken litter has in terms of cost and ease of handling.

Results

Whether the clover clippings produced enough compost to meet the single season need of a four-acre garden will not be known until the tests are conducted in spring on the soil and the finished compost. Two factors will make the results less than conclusive. First, the unusually hot, dry summer of 1995 limited the clover's growth and, therefore, the available clippings. Second, in experimenting with different carbonaceous materials it was discovered that pine sawdust immobilizes nitrogen. That pile is not expected to return as much finished compost as the other piles, which used less clover.

Other questions have been raised during the course of the research, including:

How much does mowing the clover adversely affect beneficial insect populations? Would the benefits of clover be greater if clippings were turned directly into the soil rather than composted? How does mowing affect the nitrogen-fixing ability of the clover?

Outreach

A field day was held June 4, 1995. The whole system of using clover as a living mulch in organic vegetable production was presented along with a demonstration of the composting project. The 42 attendees included farmers, Extension personnel, consumers, home gardeners and one state agriculture department representative. The ripple effect of publicity after the field day resulted in a television report and two articles in magazines, plus several new members to the Alabama Organic Fruit and Vegetable Growers Association.

The project investigators presented a slide presentation at the Alabama Fruit and Vegetable Growers Association meeting in November and at the Southern Sustainable Agriculture Working Group conference in January. The investigators are also compiling a mailing list of people interested in receiving copies of the results at the completion of the study.

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Swine Lagoon Management System

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According to information from the Department of Environment and Conservation more than 85% of operating lagoon systems in West Tennessee are out of compliance with EPA guidelines. In Dresden County, where there are more than 80 swine and dairy lagoons, most are operating out of compliance. A waste management association has been formed to provide pumping equipment, but it cannot meet the needs of even 25% of available clientele. The existing lagoons are generally 10 years of age or older, with little upgrading in the recent past.

Most (if not all) of the swine lagoons in West Tennessee are in danger of being shut down from point source pollution, which would mean the end of an industry that grosses $40 million per year for a four-county area. Most producers are not convinced of the financial validity of investing in equipment that will allow them to comply with the regulations that will keep them in business.

Objectives

1) Design a swine waste lagoon system to meet or exceed EPA guidelines.

2) Utilize lagoon effluent for irrigation and to provide acceptable levels of nutrients for intensive no-till cropping systems.

3) Maintain record keeping and cash flow program calculations, and monitor soil nutrient levels.

4) Host a field day to demonstrate lagoon management practices.

Approach

This project will demonstrate how to utilize lagoon effluent to provide acceptable levels of nutrients and irrigation for increased yields in intensified, no-till cropping systems while protecting surface and ground water. The project will take place on 100 acres of no-till, intensified crop land that is part of a 1,350-acre family farm. A swine lagoon system will be designed to handle the waste from a recently added swine enterprise on the farm, which will expand from 85 sows in 1994 to 170 sows in 1995.

Project investigators will design the lagoon system in cooperation with state and federal regulatory agencies. The lagoon itself will be oversized in order to allow for winter storage of effluent, something that was overlooked in the design of many existing systems and is now causing problems for the producers. The participants intend to demonstrate that the cost of adopting environmentally sound waste management practices in order to comply with the law can be offset by increased yields and reduced fertilizer inputs.

Outreach

The economic success of the lagoon system will be evaluated by an agricultural economist who will summarize records of cost analysis and field-by-field crop yields as well as nutrient-level yield challenges to validate expenditures.

Several on-farm field days are planned to demonstrate the system and encourage more cooperative planning among agencies and producers to adopt these lagoon management practices. The generated information will also be used in Extension publications.

No report was submitted for this project in 1995.

Project area
Organic production

Project duration
July 1994-Dec. 1995

Budget:

SARE	$10,000
ACE	
Matching	$ 20,550

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Plant Shelters to Extend the Growing Season for Herbs

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A limited growing season in the mountains of western North Carolina prevents the production of quality herbs beyond the summer months. The region produces high quality herbs, but the limited growing season forces growers to become only part time producers with diminished opportunities for financial return. The normal growing season for herbs, June through September, is also the period of highest labor use and lowest price return for their labor.

Few small producers can afford the initial investment or operational expenses of greenhouses. A solution to this barrier is the development of small scale, affordable and portable plant shelters to extend the growing season of specialty crops in the mountains.

The growing season of several herb plants could possibly be extended (through the use of shelters) from the late frosts of April and May to the early cold snaps in September and October. Portable shelters placed in the fields at planting time could possibly sustain a growing season of eight months instead of four months. Such an extended season has the potential to triple the income from a given number of plants or production area due to premium prices being paid during months that herbs are usually not available.

Objectives

1.) Develop and test plant shelters designed to extend herb growing season.

2.) Host a field day and/or workshops to demonstrate the use of plant shelters to extend the herb growing season.

Approach

The project aimed to design shelters that were lightweight; portable; inexpensive to construct, maintain and store; easy to operate, energy efficient and re-usable for several seasons. The shelter system was also designed to have a drip irrigation component to accommodate the extended growing season and periods of drought.

The success of the shelters was to be measured by the extended length of the growing season, the increased supply of herbs harvested and sold through the market cooperative and the financial return to the farm. Records were to be maintained to demonstrate the cost effectiveness of the shelters and irrigation system.

Results

Field tests conducted in this project did not identify any construction materials or designs that performed adequately for commercial production of herbs. All of the designs used greenhouse plastic stretched over frames made of various materials. The frames were 12 feet long, 4 feet high and 6 feet wide. They were sized to fit over two greenhouse rows when the plants were young and one outside row when the plants were transplanted.

The first materials evaluated were 3/8-inch metal pipe and 2-inch locust saplings. Both of these materials resulted in structures that were too heavy to be portable.

They were cost-effective for this producer because he obtained used pipe at a very low price and cut the locust saplings from his own property. In his opinion, if those materials had to be purchased at a greenhouse supplier the cost would be comparable to building a new permanent greenhouse, making those materials cost prohibitive.

Rectangular shelters constructed of 3/4-inch PVC pipe showed promise in that they were lightweight, portable and inexpensive. However, when subjected to high winds they blew over and damaged the plants. At that point inexpensive, reuseable anchors were evaluated. Again, locust saplings were cut from the producer's property and used in a manner similar to tent stakes. However, they had to be pulled out of the ground in order to move the shelters or open the plastic covering for venting on sunny days.

A second set of PVC shelters were made in quanset hut style with the pipe bent into hoops four feet high and six feet wide at the base. They failed to survive the winter as the bent piping shattered due to a combination of pressure and low temperatures.

After the hoop design, a triangular PVC frame was tried, but it sacrificed too much room, especially head room, to be practical.

To other farmers considering the use of portable shelters, this producer suggests they may try PVC pipe made into rectangular frames with, perhaps, a heavy gauge wire for anchors.

He also suggests they may look into herbs that have a lower growing pattern than basil. Since basil requires a frame about four feet

Project area

Organic production

Project duration

July 1994-Dec. 1995

Budget:

SARE	$ 3,550
ACE	
Matching	$ 3,350

high, most any material that would be light enough to be portable would also be subject to blowing over in windy conditions. If basil is the herb of choice, then shorter frames (24 inches) could be used to extend the beginning of the growing season while the plants are still small, but would be useless to extend the end of the season when the basil matured.

The irrigation component did not ever reach testing stage as a flood in 1994 washed out part of the irrigation system and another storm in 1995 washed out the stream intake, delaying installation until mid-summer. Then a road construction project upstream deposited mud into the stream, clogging the drip pipes so that no irrigation was possible during drought season.

During the project, market prices for this producer's herbs dropped due to the unexpected availability of inexpensive herbs from Mexico, Israel and Australia. His normal price of $5 per pound for basil dropped to $4 per pound, and he still could not compete with prices of $2.50 per pound, which caused him to leave much of his crop unharvested. With inexpensive imported basil becoming available year-round, he now considers it unlikely that he will invest in irrigation systems or shelters or even remain in the culinary herb business. He and other North Carolina growers are concentrating on medicinal herb production.

Outreach

There was never an opportunity to demonstrate a working system in this project due to the design weaknesses in the frames and to the irrigation system problems. The producer made a presentation to the local high school agricultural students where the students had an opportunity to suggest design and material ideas for the portable shelters. The producer gave several tours to people who learned of his operation through the Extension agent.

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Cut Flowers as a Sustainable Agriculture Alternative

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Recently available figures (1989) indicate Oklahoma revenue from cut flower sales reached over $9 million that year. Of this, only $300,000 was produced in Oklahoma. National wholesale production of cut flowers and greens is estimated at over $560 million per year. Production of specialty cut flowers (all species except roses, chrysanthemums and carnations) is a rapidly growing section of the cut flower industry.

Many cut flowers are imported into the region from other countries. The Mississippi State publication, *Inventory of Non-traditional Agricultural Commodity Activities in the Southern Region* (1990), lists only three references to floriculture and production; they are located in Kentucky, Mississippi and Washington D.C. In Oklahoma the diverse soil and weather conditions and the long growing season could allow production of numerous cut flower species, ushering the small farmer into heretofore untouched markets.

Many small farm operations in Oklahoma are experimenting with sustainable crop alternatives to their conventional crops. Berries, herbs, legumes and organic vegetables have proved to be popular sustainable alternatives to corn, wheat and cattle. Cut flowers typically are not among the crops considered for agricultural alternatives. Production literature, research and essential start-up information about cut flowers is virtually unknown in Oklahoma.

In this project, two producers converted wheat acreage to a cut flower production system in order to evaluate the feasibility of cut flowers as an alternative crop in Oklahoma.

Objectives

1.) Develop a prototype of a mixed-species specialty cut flower production system.

2.) Test the use of rye and other winter cover crops as a nitrogen source and as companion plants for specialty cut flowers.

3.) Develop "how-to" materials about the incorporation of cut flowers into sustainable farming systems.

Approach

The prototype, expanded from one-half acre the first year to three acres the second year, accommodates woody plants such as pussy willow, lilac, butterfly bush and forsythia; annual and perennial flowers; bulbs and groundcovers such as ivies and lily of the valley. The species were selected to allow year-round harvesting, with many species harvestable three months of the year.

Currently two and a half acres are set up in 12 eight-row sections. The rows are actually 36-inch raised beds, divided by a walkway to accommodate a small tractor with tiller attachment. The beds are watered by a trickle irrigation system that delivers eight to ten gallons per minute.

A 14-14-14 formula fertilizer was applied when the beds were built, sidedressing after that as needed. It is anticipated that summer and winter legumes and legume-based mulches will meet future fertility needs.

In the winter of 1994 a rye cover crop was planted on the entire three acres. It was turned under and chopped when the beds were rototilled in the spring. Although this produced a good stand, the producers switched to a mixture of annual rye and austrian winter pea in 1995 after consulting with agronomists at OSU.

In spring 1996, the cover crop mixture will be evaluated for breakdown, soil texture enhancement and cost as compared to annual rye alone. Soil samples will be compared to samples taken at the beginning of the project to determine how much, if any, additional fertilizer is needed before the growing season gets underway. A composting program will be initiated in 1996 to complement the green manure/cover crop system.

In 1996 red clover will be evaluated as a companion plant to the flowers. It will be planted between the beds of flowers for weed control. Additionally, the growers hope the red clover will contribute to increased nitrogen, improved soil texture and increased numbers and varieties of beneficial insects. Beneficial insects, particularly ladybugs, were responsible for keeping chemical costs down in 1995. Crimson clover is reputed to attract beneficials.

Weed control is done by hand or with the tiller, except for over-the-top applications of a postemergence herbicide for tough grasses in the rows. Insects have been controlled with a few applications of *Bacillus thuringiensis*.

Crops include a dozen varieties of sunflowers, statice, five varieties of celosia, three

Project area
Alternative crops

Project duration
July 1994-Dec. 1996

Budget:

SARE	$ 6,000
ACE	
Matching	$ 3,100

kinds of zinnias, cock's comb, gaillardia, ageratum, salvia, ornamental okra, dill, lisianthus, liatris, snap dragons, stock, bachelor buttons, early season Queen Anne's lace, baby's breath, shasta daisy, butterfly weed, sea oats, several millets, sorghum and switch grass.

Detailed production and profit records are kept on each crop to fine-tune the growing and marketing system.

Results

The growers have found the cut flowers to be a successful alternative crop for their operation. They anticipate turning a profit and paying salaries to themselves from the farm's proceeds in 1996.

Marketing remains the toughest problem they face. Education has been identified as their most effective marketing strategy. Florists are unfamiliar with the flowers the producers are growing and, therefore, don't know how to order them or make use of them. The growers are addressing this educational need with regular visits to area florists in order to share the latest information on flower species and postharvest care.

Outreach

The producers, working in conjunction with OSU, horticulturists have produced a fact sheet about cut flower uses and postharvest care. This has been distributed to florists and to ATTRA.

They made presentations at the OSU Cut Flower conference, Texas Speciality Cut Flower Conference, the Horticulture Industries Show in Tulsa and numerous garden clubs. A field day at their farm was held in September, 1995, and 40 people attended.

The producers cooperated with Benary Seed Company on postharvest trials of zinnias, lobelia, scabiosa and gaillardia. The vice president of Benary attended their field day and later presented the results of their trials at the Speciality Cut Flower Conference in Baltimore. In 1996, the growers will continue their cooperation with OSU and Benary and continue making presentations at garden clubs and commercial horticulture meetings.

An article in *Oklahoma Farmer-Stockman* featured their operation in a cover story complete with color photos.

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Farmer to Farmer Transfer of Knowledge About Management Intensive Grazing

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Project area
MIG systems.

Project duration
July 1994-Dec. 1995

Budget:

SARE	$ 9,988
ACE	
Matching	$22,133

There is a need for more practical information for producers who are considering management intensive grazing (MIG) as an economically viable, environmentally sound alternative to purchased feed inputs. Producers often communicate more effectively with each other than they do with other agricultural information servers. They often look to other producers as their most credible information source, particularly when they are considering trying new agricultural techniques.

Objectives

The main objective of this project was to form a network of graziers with differing amounts of experience to cooperatively define and address knowledge gaps. The following process was established to obtain that objective:

1.) Hold quarterly farm meetings to discuss management intensive grazing and to share observations regarding different grazing systems.

2.) Establish transect lines (in at least one managed area on each farm) to be used for baseline and comparison measurements throughout the study.

3.) Condition score cattle quarterly to evaluate the quality of the forages as feedstuffs.

4.) Utilize NIRS fecal sampling to assign feed value to forages utilized in management intensive grazing.

5.) Share research results at conventions and meetings, and host field days to demonstrate management intensive grazing.

Approach

The four participants of this project formed a network to fill the various information gaps in their operations. Three of the participants had seven, three and two years experience, respectively, in management intensive grazing. The fourth participant was launching a grazing program in conjunction with the start of the project. Two of the participants raise beef cattle, one has a dairy and one has beef, sheep and goats. They shared knowledge from their own experiences, computer programs, videos and publications in 16 meetings during the project year to help each operation attain the highest quality forage with the least expenditure of money and labor.

Besides providing an opportunity for information exchange, the meetings were also used for pasture walks during which the participants collected data about plant diversity and forage availability. The plant inventories conducted on each walk were compared to previous inventories.

Along with conducting visual observations, they also condition scored cattle and collected forage and manure samples during the pasture walks. The manure samples were analyzed by Near Infrared Reflectance Spectroscopy (NIRS) to evaluate diet quality. Forages were tested for feed value and mineral content. The condition scores of the cattle were recorded on the same charts as the manure analysis for correlation purposes. A module in the Grazing Lands Application computer program was used to recommend supplements.

Changes in pasture management were made according to the condition scores and the results of the data sampling on each operation.

Although such routine tasks can be done by a producer at any time, this project used them as a way of opening discussions for the group. The participants also benefited from the critical observations of the group since change is more evident to someone who has not seen a particular farm in three months than it is to the producer who sees it everyday.

Results

The data supplied by the tests provided more information than most cattle producers have about their operations. Interested producers could request the necessary forms for manure and forage analysis directly from labs, follow the collection procedures and produce usable information about their own farms. Using charts for beef nutrition requirements available from county Extension offices, ranchers could see how much of the required nutrition their forages were providing. In some Southern states local NRCS offices are already utilizing the Grazing Lands Application program, and others will be able to supply this service soon.

Utilizing the data, the project participants discovered ways to improve their operations and to refine the testing process for maximum efficiency.

Based on their year-long experiences they anticipate that during the growing season, bimonthly or quarterly sampling will provide

adequate information about forage quality. During slow growth periods, particularly in winter under stockpile conditions, weekly testing will probably be needed for the first year or two to define the pattern of quality on a given farm. They expect that a spot check every two to four weeks should be sufficient after that, depending on the level of management.

They found that optimum performance was achieved when the plane of nutrition was level. Gradual changes were not as detrimental as abrupt changes in the diet. As they became more experienced with sampling they developed a feel for the expected results based on the appearance and texture of the manure. This kind of experience can reduce the amount of testing to critical periods or when a different class of stock is added to the herd.

The participants discovered that the level of management is a matter of personal choice. Some producers consider two to five day rotations and only 10 to 20 paddocks sufficient. Others believe that the steady, high quality nutrition necessary for dairy or stocker profits requires daily (or more frequent) moves, which in turn, require more paddocks or more temporary subdividing of existing paddocks.

They found that conducting a forage species inventory at least every quarter helped them better understand what is available and how well and when the stock was utilizing it.

During the project new questions surfaced that the group would like answered. They would like to know more about the mineral, protein and energy values as well as the palatability for all the potential forages throughout the seasons. They also want to find out if quality and tonnage would increase if herds were managed to stay within the rapid growth range of forages.

Economic advantages of very intense management, such as daily or more frequent moves, need to be studied. Based on their experiences, the project participants think that a management procedure based on such frequent moves could replace feedlots as a finishing technique or could speed up calf growth without damaging the cow in a cow/calf operation.

Outreach

Outreach was steady and extensive throughout the project. The pasture walks and meetings were announced to the public through mailings and in farm/general interest publications. The communication efforts paid off in the form of several visitors at the meetings and unofficial participants being added to the network as the project progressed.

Field days at the farms were expanded beyond education about the project to include herd dog demonstrations, bar-be-ques and other activities. Experts in irrigation, grazing cell management, fencing, mixed species grazing and other related topics gave presentations so that attendees could spend an entire day learning about all aspects of management intensive grazing. Approximately 80 people attended the field days. The participants also made numerous appearances at farm shows and seminars throughout the South.

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Clover Cover Crops, Weed Management and Consumer Tolerance to Insect Damage

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This project addressed three questions that arose naturally from a diversified family farm operation that sells to 50 regular customers and through a food co-op of 300 members.

1.) Can crimson and subterranean clover be used to replace synthetic fertilizers and reduce erosion? Which clover is better?

2.) How much insect damage will consumers tolerate when they purchase vegetables for home use?

3.) How effective are weed management alternatives to synthetic herbicides for vegetable production and sustainable farming practices?

Objectives

1.) Conduct a consumer survey to define potential market for the insect-damaged crops, and test different insect management practices that correspond to survey results.

2.) Compare crimson with subterranean clover as a cover crop and green manure crop for broccoli, crowder peas and sweet corn.

3.) Test alternative weed management strategies and compare the weed control efficacy and costs associated with the use of mulches, handweeding and herbicides.

Approach

As a cooperator in the project, a local food co-op surveyed their 300 members on willingness to buy sweet corn with earworms, crowder peas with stings from cowpea curculio and broccoli with worms. Information obtained from the surveys was used to determine the extent of insect management necessary for each crop. Concurrent cropping experiments were planned to compare the amount of insect damage on crops with no synthetic insecticide to the amount of damage on broccoli treated with Dipel, sweet corn treated with Sevin and peas treated with Thiodan.

The survey indicated that since most of the co-op members grew crowder peas they would not be purchasing them, so crowder peas were dropped from the cropping experiments. In other categories, 100 percent of the members indicated they would buy sweet corn damaged by ear worms. However, broccoli was viewed differently: 50 percent would buy their total broccoli supply without worm control by Dipel, 30 percent would buy half their broccoli without worm control by Dipel and 18 percent would not buy any of it without worm control by Dipel.

Since the survey indicated the food co-op members would purchase only about 25 percent of the grower's broccoli crop, all of the broccoli was treated with Dipel to satisfy the conventional market outlet. In contrast, the demand for sweet corn by the food co-op members accounted for the total corn crop, which allowed the producer to comply with their wishes to have pesticide-free sweet corn. In an adjacent town, the produce market would not buy sweet corn with any earworm damage. The survey pointed out the need for a producer to know area market demands.

Results

Based on the survey answers, no Sevin was used on corn. In 1994, 80 percent of the corn was infested with earworms, and the members purchased it without major complaints. In 1995 corn earworm moths were less numerous and only about 16 percent was infested with earworms. Members purchased them without complaint.

For cover crop trials, subterranean and crimson clovers were planted in separate ¼-acre terraces in the fall and tilled under in the spring, two weeks prior to transplanting broccoli and planting sweet corn. As green manures, both clovers gave excellent yields for broccoli in 1994 and 1995 (1,100lbs/acre).

In 1994 sweet corn was destroyed by excess rain and three severe wind storms. At the time the sweet corn was blown down (silking stage), no major differences in growth of sweet corn were detected between crimson and subterranean clover.

In 1995, sweet corn yields with subterranean clover were 30 percent of yields with crimson clover. The growers discovered that crimson clover also was easier to rototill, produced more biomass and reseeded itself.

Based on three years experience, broccoli and sweet corn yields with crimson clover were equal to previous yields with synthetic fertilizers. These field trials indicated that for short season crops, such as broccoli, crimson and subterranean clovers as green manures provided adequate nutrients and could be substituted for synthetic fertilizers. For long season crops such as Silver Queen sweet corn, crimson clover was adequate as a green ma-

Project area
Cover crops, weed control and consumer survey

Project duration
July 1994-Dec. 1995

Budget:

SARE	$ 4,710
ACE	
Matching	$5,918

nure for nutrients but subterranean clover was not suitable.

The weed management tests compared 20-foot sections of 200-foot rows that were subjected to grass mulch, paper mulch, herbicide in reduced amounts, hand weeding or no weed control.

Grass clippings and paper mulch provided adequate weed control and crop yields. Based on that success, the participants expect that grass clippings and paper mulches could provide cost-effective weed control in communities where they present a waste disposal problem.

However, their use was found to be labor intensive. In these field trials, 726 hours per acre were required to gather and distribute grass clippings, and 363 hours were needed for paper mulch. The growers note that such time factors may not present a strong negative for home gardeners or for larger operations with mowers more efficient than an eight-horsepower riding mower to collect grass clippings.

Paper mulch revealed two potential drawbacks. A 20 percent early-season stunt in sweet corn in 1994 was attributed to a cooler soil temperature and less decomposition of soil organic matter, thus less available nitrogen than the grass-clippings, handweeded or herbicide treatments.

In 1995, paper mulch on broccoli increased the number of slugs to the point of crop damage. Paper provides cool damp conditions conducive to slug growth, and, perhaps offers more protection from predators as compared to mulches made from grass clippings.

Hand weeding required 100-200 hours per acre at $5 per hour, which would mean a labor cost of at least $500 per acre. This is less costly than the labor required to handle paper mulch (363 hours) or grass clippings (726 hours).

By using a band rather than broadcast application of herbicides, the amount used per acre was reduced by 67 percent. The labor cost to apply that herbicide with a backpack sprayer would be about $30 per acre.

The remaining treatment, no weed control, had no labor costs but crop yields were reduced by 40-70 percent due to weed competition for nutrients and water.

In conclusion, according to these on-farm tests, profitability after subtracting only labor costs for weed management treatments would be ranked high to low as follows:

1.) herbicide
2.) hand-weeded
3.) paper mulch
4.) none
5.) grass clippings.

For example, after deducting only the labor cost for weed management treatments, the profitability for sweet corn ranged from approximately $2,400/acre to a loss of $1,200/acre for the grass clippings.

Outreach

Field days were held in June and July, 1995, for a total attendance of about 50 people. A demonstration of insect sweeping was presented, and a sample sweep indicated significant insect diversity on the cooperator's farm. A fact sheet on the 1994 broccoli results was distributed at both field days. The participants are available to present slides and talks to grower groups and other interested people.

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Shrimp Polyculture on Existing Farms

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For family farms to survive and grow, alternative income opportunities must be found. Although universities are working on sustainable agriculture opportunities, ideas that work well in a research system are often impractical when applied to the family farm. Freshwater shrimp polyculture research has been confined to university-level trials with astounding production success, but little information has been gathered as to the economics, practicality or commercial product utilization of freshwater shrimp as a farm product. This project applied university-level research to demonstrate an on-farm shrimp culture.

Shrimp is the world's most valuable aquaculture industry. The United States alone imports an estimated $1 billion in farm-raised shrimp annually. Strong economic growth in many Asian countries is fueling additional demand, while production increases are limited by disease problems in a number of countries. These factors have resulted in increased shrimp prices over the last two years. United States shrimp imports are expected to remain in the 500-million-pound range for the next several years. Continued international price increases could cause restaurant and food service companies to look for substitute products and increase the demand for domestic catch (*Aquaculture Outlook*, 1995).

Objectives

1.) Establish a freshwater shrimp production system in an existing farm pond.

2.) Collect water quality, production and cost data on shrimp production systems.

3.) Host a field tour to demonstrate the integration of shrimp production into sustainable agriculture systems.

Approach

On a 93-acre swine and beef farm, two existing livestock ponds were used to demonstrate that raising shrimp can provide extra income and not affect the ponds' ability to provide stock water. In 1994 the ponds were cleaned, fitted with a three-to-one slope on the sides to minimize growth of cattails and other hydrolytic vegetation and fitted with drain pipes that allowed complete drainage. The 0.2-acre pond, which was to be managed intensively with daily feeding and aeration when necessary, was wired for electricity allowing connection for an aerator. The one-acre pond was managed extensively. Both ponds were allowed to fill naturally with winter rain and run-off.

In early June the ponds were stocked with embryonic shrimp shipped from Texas. The 0.2 acre pond was stocked with 3,200 shrimp scheduled for daily feeding. The one-acre pond was stocked with 7,000 shrimp. Regular water sampling for dissolved oxygen indicated early that an aerator was going to be needed in the intensively managed pond. Even with a ram pump bringing in fresh water from a third pond, the heat and drought in late June depleted oxygen levels so that a larger aerator had to be purchased. Problems with excessive aquatic vegetation required weekly hand cleanings.

Feeding levels in the small pond began at three pounds per day and rose to 12 pounds per day for the last three weeks. There was no way to know at the time how much of the pelleted feed was eaten and how much went into organic biomass that fed the plankton and thus fed the shrimp. Total feed consumption was 750 pounds. Also some phosphorus fertilizer was added to increase biomass in the pond. Oxygen levels were sampled by chemical titration methods weekly throughout the season and every three hours the last week when the cold weather necessitated turning off the aerator at night.

Results

Harvest took place September 26. Early unseasonably cold weather reduced the yield. Also because of the cold weather, when the ponds were drained for seining, the shrimp burrowed into the mud rather than jumping into the seine as they would have in warmer weather. Harvest could only be completed by hand harvesting the shrimp out of the mud and then dumping them into a stock tank for cleaning. Despite the problems, nearly 200 pounds of shrimp were harvested.

The shrimp, which started the project weighing one gram each, averaged at harvest 42 grams each. That's approximately 10-12 per pound live weight. Since tail weight is one half of live weight, the tails were approximately 20 per pound.

Through previous sales of sweet corn and tomatoes, lamb and pork the farm already had in place a customer base for quality foods.

Project area
Alternative crops

Project duration
July 1994-Dec. 1995

Budget:

SARE	$ 3,109
ACE	
Matching	$ 1,850

Taking advantage of this, the producers announced they would sell the shrimp right out of the pond—live weight at $6.00 per pound. The price was based on processor prices and prices at grocery stores. Although a few were held for sale to a Kroger store, the participants are of the opinion that direct sales from the pond or from a tank at a farmers market will be the most effective marketing strategy.

A survey was mailed to those who bought or received shrimp from the pond. All the responses were positive and enthusiastic about the flavor, texture and size. At $6.00 a per pound, 27 responders said they would purchase a combined total of 540 pounds per year.

The producer plans to expand the shrimp operation by digging three more ponds and adding paddlefish as an additional crop. All the ponds will be aerated and intensively managed so that aquatic vegetation levels can be minimized and oxygen supplies can be maintained. They will also be investigating the best method of developing algae bloom which limits sunlight entrance into the pond, a major factor in vegetation control. Although water and soil sample analysis is not yet complete, it appears shrimp have little impact on water quality. The producers observed that because the shrimp consumed bottom dwellers and algae, the pond water was actually cleaner looking than in previous years.

Outreach

A field day is scheduled for June 1996. A large crowd is expected since the shrimp project has sparked a lot of local interest.

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Biological Control of Flower Thrips in Pepper Fields

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Objectives

Since 1989, when the first specimen was identified in south Florida, the melon thrips, *Thrips palmi*, and the western flower thrips, *Frankliniella occidentalis* have become established in that area. Pepper plants are one of their preferred hosts, and they can cause devastating crop losses if left uncontrolled. Controlling these thrips without setting off secondary pest problems or accelerating resistance in other species is a problem soon to be faced by many vegetable and row crop growers as these pests spread. Conventional insecticides that can be used for control are known to eliminate beneficial insects, such as minute pirate bugs and parasitic wasps, which play a key role in managing thrips as well as other pests, such as armyworms. USDA entomologists predict that the range of *Thrips palmi* will extend north into Georgia, and west to the Pacific Ocean. Accordingly, nearly all of the nation's winter pepper production is at risk.

The objectives were to:

1.) Monitor, collect and identify, on a twice weekly basis, fields and nurseries to determine insect (damaging and beneficial) populations.

2.) Test alternative pest management strategies. Compare costs, crop yields and crop quality of traditional commercial insect control practices to alternative, biological control practices.

3.) Test the use of predatory nematode *Steinernema carpocapsae* as a biological control agent for thrips.

To achieve these objectives, the researchers examined four specific areas, all related to biocontrol and pesticide use reduction. These included the use of different cover crops as predator nurseries, application of a predatory nematode to control adult thrips emerging from pupae, release of predatory insects to control adult thrips and the release of predatory mites to control broadmites.

Some of the experiments were hampered by tropical storm Gordon dumping over 12 inches of rain on the farm in November 1994. Regardless of the weather, results show that biocontrol was an effective alternative to relatively toxic pesticides in the on-farm trials.

Approach

Green Cay Farms raises 225 acres of green peppers each year along with 100 acres of squash and cucumbers. In the summer of 1993, participants planted clay peas and sorghum as cover crops in non-crop areas at Green Cay Farms. These had to be moved off shortly after bed preparation began, due to the tall growth of sorghum and weeds, which interfered with farm machinery. During the summer of 1994 the participants tried Alyce clover and *Aeschynomene*, both legumes, as cover crops. Rank growth of the latter resulted in these being mowed soon after peppers were planted. During both seasons, very few thrips or their predators were collected from any of these species. However, based on twice-weekly scouting reports from Glades Crop Care, Inc., an increase of several predator species occurred in the pepper crop shortly after the cover crops were mowed. This may have been coincidental with the seasonal incidence of these predators, or may indicate their activity was increased after being forced out of the legume cover crops by mowing.

The participants also monitored insect populations in a native weed species, *Wedelia triloata*, found growing abundantly on the ditch banks. This particular weed harbored large numbers of a non-destructive species of thrips, as well as predatory insects, and will be examined further in the future. Future testing of such nursery areas will include a more critical selection of cover crops. The researchers will be seeking plants with a prostrate growth habit that does not interfere with farming operations and that will continue to flower through Florida's winter season.

In 1993 Glades Crop Care had tested an introduced beneficial nematode, *Steinernema carpocapsae*, at a pepper growing site in Charlotte County, FL. Results from that test showed significant reductions in emerging adult thrips, so the test was repeated on the grower's farm with similar results. The nematode product was Biovector, manufactured by BIOSYS. This product turned out to be more economical than a mass release of predatory insects purchased from a commercial insectary. Emergence traps were sampled for thrips in both treated and untreated areas at seven and 14 days after treatment (DAT). In all cases, the areas treated with Biovector showed reduced numbers of emerging thrips.

Having heard of successful control of

Project area

IPM

Project duration

July 1994-Dec. 1995

Budget:

SARE	$ 9,950
ACE	
Matching	$10,900

broadmites (a major pest of peppers) and western flower thrips at The Land in Disneyworld's EPCOT Center using the predatory mite, *Neoseiulus barkeri*, the participants decided to try releasing this mite at Green Cay Farms. Release was made in October 1994, in time for a minor seasonal peak in western flower thrips.

The presence of the predatory mites seemed to have little effect on thrips populations or the damage they caused. Very few of the released mites were observed during regular scouting, and they did not satisfactorily control the broadmite infestation. Therefore, it was decided to apply a miticide to control broadmites, thus ending this release experiment. Weather or some other factor may have affected the field survivability of the predatory mite; however, the successful control achieved at Disneyworld makes the researchers think this control method is worth a second look.

The possibility of augmenting the beneficial insect population was investigated, particularly *Orius insidiosus*, a common, seasonal thrips predator and one that appeared soon after the cover crops were mowed. The collections indicated that this insect has seasonal peaks in mid-fall and again during the spring. During these peaks they exert significant control over thrips infesting some crops. However, they enter diapause during the short days of winter, thus removing themselves from the scene. A release in a quarter-acre plot was made in late December 1994, with a second release made two weeks later. The timing was arranged to see if *Orius insidiosus* would become established during this off season. Such establishment would offer the possibility of enhanced biological control of thrips later in the spring. Weekly examination of pepper blooms and growing points near the release site showed that very low levels of *Orius insidiosus* were present shortly following release. Although the crop was blooming abundantly at the time of release, foul weather and crop maturation caused a progressive decline in the numbers of thrips prey, and their tendency to enter diapause resulted in no recovery of *Orius insidiosus* during the last weeks of the monitoring period.

A preliminary review was made of the economics of the participants' pest management practice, compared to those of other growers in the area. The participants found that the cost of their program was much less than those of their neighbors. The participants used primarily *Bacillus thruingensis* (B.t.) products and Neemix in their regular control program, with only one application of Lorsban, a relatively toxic pesticide, to control a large influx of armyworms in one plot.

Between the fall and spring pepper crops in 1994-1995, the participants had an average chemical cost of $251.95 per acre, while the average projected for Palm Beach County was $591.00. This average was obtained from the 1993-1994 "Production Costs For Selected Vegetables In Florida" circular published by the University of Florida. This translated to a chemical cost of $0.22 per package at Green Cay Farms as compared to $0.52 average for Palm Beach County.

If the growers look at both the economic and environmental costs of strictly conventional pesticides, the savings become much more dramatic. By moving to a biologically oriented spray program, the growers were able to decrease total chemical costs by over 68 percent. In addition, the worker risk factor for biological control is much lower than that of conventional pesticides.

Results

In conclusion, the research found that cover crops are helpful in providing refuges for predatory insects, but more covers with prostrate growth and a winter flowering period need to be identified. The predatory nematode *Steinernema carpocapsae* provided good control of emerging adult thrips, however, release of the two predatory insects, *Neoseiulus barkeri* and *Orius insidiosus*, were not very effective. Finally, the participants' reliance on biocontrol products in their pesticide program was found to be very cost effective.

The success of the grower's general IPM program, which closely integrates field scouting, cultural practices and the use of relatively safe pesticides demonstrates that economical pest control can indeed be achieved using these methods. When selecting cover crops in the future, the grower will carefully evaluate the growth habit of the species chosen. Particular attention also will be paid to the life cycle of the cover crop and how that relates to critical time periods in the vegetable crop, as well as habitat suitability for the target insects.

While the release of predatory mites and insects did not produce satisfactory control in these experiments, the literature indicates many successful examples exist. Environmental conditions may have adversely affected the particular predators that were released, so these particular species should not be dismissed as a viable control method. The application of Biovector proved extremely effective in reducing the number of thrips pupae emerging from the soil. Since a current method does not exist for providing dependable conventional chemical control, this may prove to be the best method currently available for *Thrips palmi* control.

Outreach

Participants made presentations at a vegetable growing seminar hosted by University of Florida Cooperative Extension Service and a monthly Extension Service meeting. They also assisted in a media workshop entitled IPM: In Partnership with Nature, which was sponsored jointly by the National Foundation for IPM and the International Food Information Council. In attendance were 25 food editors from around the United States, including CNN, *Progressive Farmer Magazine* and the *Los Angeles Times*.

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Southern Region

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No-Till Vegetable Demonstration

Project Coordinator

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Due to increased regulations and loss of farmland, fewer acres in the South are available for vegetable production. Of the available acreage, some is not suitable for production because the slope is too great for conventional production practices.

This producer has developed a no-till system for vegetable production that, compared to conventional tillage methods, uses fewer chemicals, reduces erosion, utilizes cover crops for moisture management, and allows planting and harvest in times when conventional methods don't allow access to the field.

Objectives

1.) Demonstrate no-till compared to conventional-till production systems for cabbage, tomato and pepper in three regions of Virginia.

2.) Develop a videotape and manual on no-till vegetable production.

Approach

Farmers and agricultural service providers will meet to establish an agenda for conducting demonstrations of the producer's no-till system for vegetable production. The producer will select sites in three major regions of Virginia (Mountain Southwest, Piedmont and Coastal Plain. A minimum of six sites (two sites per region) will be chosen for the demonstration of no-till vegetable production systems. Conventional-till production systems will be selected and used as comparisons to the no-till system.

Outreach

A videotape and manual entitled *Guidelines for No-till Production of Transplanted Vegetables* will be developed as part of the project. The producer will make copies of the videotape and manual available throughout Virginia and disseminate them to interested farmers, grower organizations and agricultural service providers.

Cooperators

Gary Larrowe
Extension Agent
Carroll County
Virginia

Southwest Virginia
Agricultural Association
Abingdon, VA

Southwest Virginia's
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Ronald Morse
Horticulture
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Fred Rogers
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Galax, VA

Project area

No tillage

Project duration

July 1995-Dec. 1997

Budget:

SARE	$8,300
ACE	
Matching	$17,200

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Pecan IPM Using Black-Eyed Peas as a Trap Crop

Project Coordinator

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Cooperators

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Stinkbugs occur throughout the South and cause kernel damage to pecans in all pecan growing states. In Texas, most stinkbug damage occurs August through November when stinkbugs move from nearby crops and weeds. Stinkbugs cause a direct loss of three to five percent of the economic returns from southern region pecans, although losses within individual orchards can reach 40 to 50 percent.

Using their needle-like mouthparts, stinkbugs pierce the pecan shells and feed on the maturing kernels. The resulting damage is a dark, sunken, bitter-tasting spot on the pecan kernel (kernel spot). Farmers are not paid for stinkbug damaged kernels.

Preliminary information suggests that small plantings of black-eyed peas in pecan orchards can help pecan growers manage stinkbugs. The bugs are attracted to the black-eyed peas on which they may feed preferentially, potentially reducing pecan kernel damage.

Objectives

Determine if black-eyed peas serve as a trap crop for stinkbugs, reducing damage in pecan orchards.

Approach

Black-eyed peas will be planted on two to three dates from mid-July through mid-August 1995 and 1996 in existing pecan orchards. Peas will be sampled using a 15-inch sweepnet from August through October. Stinkbugs and other insects deleterious to pecans will be counted and identified. At harvest in October or November, nut samples of pecans will be taken at various distances from the black-eyed pea trap crops. Each sample will be cracked and percent stinkbug-damaged nuts and kernels will be counted.

Outreach

Results will be published in the agriculture popular press (e.g., *Pecan South Magazine* and *Southwest Farm Press*) and newsletters. Project results will also be presented at the Texas Pecan Growers Association meeting, the Permian Basin Pecan Conference, and to the Southwestern Irrigated Pecan Growers.

Project area

Pest management

Project duration

July 1995-Dec. 1997

Budget:

SARE	$4,000
ACE	
Matching	$4,098

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No-Till Grain Production for Soil and Moisture Conservation

Project Coordinator

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Cooperators

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Monsanto Chemicals

Russ Perkins
BASF

Raymond Miller
Ciba Geigy

Jack Lyons
DuPont Chemicals

John Cagle
Miles Laboratory

Junior Allard
Panhandle Implement

David Austin
PBI/Gordon

Collingwood Grain

Producers:
Glen Plunk
Delmar Plunk
David Harrison

In the early 1980s, the producer was using a rotation of wheat-fallow-wheat-grain sorghum in a conventional dryland tillage system. Because of declining farm profits he realized that farming sustainably was possible only if he made some significant changes to his operation.

At that time, little local research was available on utilizing and conserving water with no-till systems, so the producer experimented with his own system to boost yield and profitability through improved water utilization and conservation. By 1984, he had a workable system that could be used by other farmers. During the past 10 years, he has continued to fine-tune the system and help fellow producers adopt parts of it for their operations.

Objectives

1.) Demonstrate the effectiveness of dryland no-till management systems for water conservation.

2.) Instruct other farmers in the adoption of dryland no-till management systems to improve water conservation.

Approach

This project is an ongoing field demonstration to show farmers that they can increase net profit with a no-till system that encourages water conservation. Past demonstrations have successfully shown other producers how to conserve water. With the increased importance of conservation compliance, no-till management will continue to be an important practice on both dryland and irrigated land.

Outreach

The producer will conduct tours and workshops on his farm. He has done this annually since 1984, with about 300 people now attending. Included in the demonstrations are short seminars by Extension personnel and university specialists, as well as presentations by other producers who have adopted this system.

Project area

No tillage

Project duration

July 1995-Dec. 1998

Budget:

SARE	$9,818
ACE	
Matching	$19,636

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No-Till Cotton Production Using Best Management Practices

Project Coordinator

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Cooperators

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Cooperative Extension
Mississippi

In the Central Hill region of Mississippi, cotton yields range from low levels of 350-500 pounds to higher levels of 700-1000 pounds per acre. Cotton yield in this area is closely tied to tillage and fertilization practices. However, these practices vary widely among producers.

Conventional deep tillage has not been shown to be consistently beneficial to cotton growth and has been implicated in increased rates of erosion. In terms of fertilizer application, it is imperative that timing, amount and method of application suit local conditions in order to acheive adequate yields while maintaining environmental quality. Over the past few years, research has shown that adequate yields can be achieved without increasing input costs, through the implementation of no-till practices and the judicious use of fertilizers. The most successful farmers who have adopted these practices have achieved yields of 1000 pounds per acre or more by using no-till management and the proper balance of fertilizer nutrients.

Objectives

1.) Compare no-tillage and conventional-tillage treatments, with and without covers of winter wheat, on cotton.

2.) Demonstrate project results to area farmers in an annual field day.

Approach

The main problem being addressed in this project is finding a practical and successful approach to the selection of tillage and nutrient management systems for soils common to the Central Hill region of Mississippi. This project is expected to require three years because of the transition of the fields from their currently disturbed condition to a realistic no-till condition. The producer hopes to validate local findings that conventional deep tillage is not consistently beneficial to cotton growth and development. If true, it will have implications on the control of erosion and nutrient leaching due to excessive rates of fertilization.

Treatments include conventional tillage and no tillage, with half the fields planted in winter wheat cover and half of the fields left bare. A yield strip will be harvested from each treatment with a specially modified picker. The seed cotton from each treatment will be subsampled for evaluation of lint and seeds.

Lime will be applied to the entire area to bring soil pH to 6-6.5. Phosphorus, potassium and sulfur will be applied to all treatments according to soil tests. Nitrogen will be applied according to soil tests, with side dressings as indicated.

Outreach

The proposed test area is adjacent to a heavily traveled local road, and farmers from the community will be able to watch the project's progress. Field days will be held during the second and third years of the project. Results of the test will also be published in local Extension bulletins.

Project area

No tillage

Project duration

July 1995-Dec. 1998

Budget:

SARE	$8,295
ACE	
Matching	$53,280

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Alternative Control of Soil Diseases in Vegetable Production

Project Coordinator

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Cooperators

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Development of non-chemical controls for soilborne pathogens are needed in the search for sustainable agricultural practices. Methods for growing a number of fresh market vegetables typically includes the practice of soil fumigation. This practice is required to control a number of soilborne plant diseases.

Recent research suggests that the application of organic wastes may reduce the incidence of several fungal and microbial diseases on vegetable crops. The application of dried or composted organic wastes (cabbage, grass clippings, food waste, etc.) has been suggested as an alternative method for currently used fumigation technology. For example, cabbage leaves have been implicated in the release of toxic chemicals upon decomposition. These compounds are believed to be released for a short time in minute amounts but may be highly effective in reducing soil-borne disease pathogens. If a practical application could be developed to utilize these compounds, producers would have a sustainable on-farm method of disease control.

Another promising control measure which does not require chemical fumigation is solarization. Typically, soil is solarized by placing a transparent plastic cover over the crop area during periods of greatest solar radiation. The trapped heat can potentially reach temperatures high enough to kill soil-borne disease agents.

Objectives

1.) Determine the efficacy of dried cabbage residue and grass clippings as a mulch for the control of soilborne pathogens.

2.) Determine the efficacy of soil solarization for the control of soil-borne pathogens.

Approach

Field plots (4 ft. x 150 ft.) will be prepared and dried cabbage residue and grass clippings will be spread over them. Other field plots of the same dimensions will be covered with clear plastic film. Strawberries followed by watermelons will be planted in the plots which will be monitored for pest and insect damage.

Outreach

Two field days will be held during the course of this study. The first will be in late summer and will focus on the use of solarization and organic amendments to prepare areas for annual strawberry production. The second field day will be held at the time of strawberry harvest. The focus of the second field day will be to discuss the success (or failure) of solarization and organic amendments in strawberry production.

Project area
Vegetable production

Project duration
July 1995-Dec. 1997

Budget:

SARE	$5,625
ACE	
Matching	$4,060

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Development of Potting Soil Mixes from Local Wastes

South Dade Nurseries in Dade County, Florida, requires a financially and environmentally sound substitute for the potting soil mix currently in use: a mixture of peat, pine bark and sand. Peat is expensive and utilizes a natural resource that could be saved if a good quality substitute can be found.

Objectives

1.) Develop a potting soil mix from composted organic materials, including sewage sludge and organic waste products that have been source-separated from the rest of the refuse stream and are currently going to landfills and incinerators.

2.) Evaluate the potting soils for fertility, moisture rentention and performance in a greenhouse setting.

Approach

The producers will experiment with various mixtures of compost. After they have identified suitable mixes that show promise as substitutes for the current mix, they will move finished compost to participating nurseries. Different species and varieties of nursery stock will be planted in the mix. Plant growth, water and fertilizer utilization will be evaluated throughout the three-year project.

Outreach

Field days, seminars and mailings will disseminate information on the new potting mix. They will educate the nursery community on the value of source-separated, clean, organic waste compost and sewage sludge as a potting medium.

Project Coordinator

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Charles Yurgalevitch
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Project area

Composting

Project duration

July 1995-Dec.1998

Budget:

SARE	$9,600
ACE	
Matching	$13,800

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Testing the Efficacy of Alternative Methods of Whitefly Control in Organic Vegetable Production

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Cooperators

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Whiteflies, including the sweet potato whitefly, the silverleaf whitefly and the greenhouse whitefly attack a broad range of economically important vegetable and field crops, and have recently increased in importance in the western and southern United States. Whiteflies damage crops by feeding on plant sap. More importantly, whiteflies are capable of transmitting viruses to a wide range of crops.

Biogeographic surveys of whitefly populations from 1989 to the present indicate that whiteflies inhabit nearly every major agricultural locale in the southwestern and southeastern states and Hawaii. Economic crop losses due to whiteflies and their associated viruses have been especially significant in Florida, Georgia and South Carolina. An important factor responsible for the whitefly's prevalence in agricultural areas is its ability to feed, multiply and survive on an extremely wide range of host plants.

On their certified organic farm in Florida, the producers observed large whitefly populations during the entire cropping season. They experienced nearly 100 percent virus infection of snap beans and tomatillo. Overall, the viruses transmitted by whiteflies are their largest production problem.

Pesticide application is the most common method of whitefly control on conventional farms. However, organic farmers interested in alternative approaches have more limited methods available for whitefly control. In this research project, the producers will conduct an on-farm experiment to determine if an economically feasible control program utilizing an integrated pest management approach can be developed for small to medium-size farms.

Objectives

1.) Determine if the use of reflective mulches under beans is an effective means of whitefly control.

2.) Determine if intercropping beans with *Nicotiana fragrans* is an effective whitefly control.

3.) Develop a botanical insecticide produced from extract of *Nicotiana gossei* and test it on squash as a control for whiteflies.

Approach

The producers will compare both the number of whiteflies and the percentage of virus infection on beans planted under the following treatments: 1.) beans planted on plastic mulch, 2.) beans intercropped with *N. Fragrans* and planted on plastic mulch, 3.) beans intercropped with *N. Fragrens* and planted on bare soil, 4.) beans planted on bare soil.

The beans will be inspected for symptoms of viral infection on a weekly basis. Whiteflies will be sampled once a week in the early morning when they are less active. At maturity, all of the bean plants will be harvested and weighed for each treatment.

The producers will prepare an aqueous solution of *N. gossei* extract and apply it to squash plants twice a week to determine if it reduces whitefly incidence and the virus it carries. Squash leaves will be sampled on the day following spraying.

Outreach

Project results will be submitted to agriculture and plant pathology journals and papers presented at the Florida Plant Pathology Society or the Florida Entomological Society. The producers will hold a field day for local growers, Extension workers and master gardeners.

Project area

Biological control

Project duration

July 1995-Dec. 1996

Budget:

SARE	$5,200
ACE	
Matching	$1,875

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High-Value, Small-Scale Sustainable Vegetable and Fruit Production Methods

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Foundation

Kenny Rogers
Agriculture Teacher
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During the last decade many farmers have gone out of business, in part due to the rising costs of land, machinery, chemicals, fertilizer and seed. Young people are finding it increasingly difficult to make the capital investments necessary to enter farming. The producers will demonstrate that a sustainable profit may be made from as little as two acres and a few purchased organic fertilizers, using no chemicals, tractors or tillers.

Objectives

1.) Demonstrate how to improve soil physical properties and fertility through the use of mulches and animal manure.

2.) Demonstrate that lowering farming inputs through the use of mulches and animal manure can increase economic sustainability.

Approach

The producers will create an additional one-acre garden on their farm specifically for this project. They will plant a series of vegetable and fruit crops over three years. The crops to be planted are corn, sweet potatoes, cabbage, strawberries, watermelon, cantaloupe and butternut squash. The garden will be divided into four equal sections and fruit and vegetable crops will be rotated on the sections during the project.

Two sections will be mulched with hay, and two sections will be covered with black plastic. The treatments will be alternated every year. Soil fertility will be maintained with manure and the decaying hay. Hand tools only will be used. The following results will be recorded: soil inputs, changes in soil texture and fertility, results of treatments per crop, gross income and net income.

Outreach

One field day is planned after the first results are available (9-12 months) with another one scheduled later in the project. The producers will work with the North Carolina Cooperative Extension Service and present their results at a public workshop at the Extension office. The workshop will cover intensive gardening and organic methods. They will also present their results at the North Carolina Vegetable Growers Expo and at the Carolina Farm Stewardship Association Sustainable Agriculture Conference at the end of the third year. Results will be reported in the Carolina Farm Stewardship Association newsletter.

Project area
Vegetable production

Project duration
July 1995-Dec. 1998

Budget:

SARE	$9,612
ACE	
Matching	$4,942

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Improving Tropical Soils by Using Organic Wastes

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Amigos Agricultura
Ecologica Santurce

Fundacion Ambientalista
Osho

Tropical Sources

Ama a tu Gente Salva el
Ambiente

Lake Carite in Puerto Rico is surrounded by forest and farmland. The farmers utilizing the land surrounding the lake grow citrus, coffee and bananas and some annual crops. Some of the fertilizers and pesticides used by the farmers are leached into the lake.

In many tropical ecosystems nutrients are held in the standing biomass and not in the soil. When the natural vegetation and nutrients are removed from the site, the fertility of the bare soil is low. In the absence of protection, the topsoil erodes, and the remaining soil does not respond well to fertilization. Consequently, the citrus crops are not responding to traditional fertilizer recommendations and fertilizer use is increasing.

The local fruit processing plant and poultry farm near the lake have waste disposal problems. A practical solution to their waste disposal and to the soil fertility problems of the farmers will be the main thrust of this project.

Objectives

1.) Construct compost piles primarily of fruit waste and poultry manure with seaweed, sand, calcium carbonate and leaves.

2.) Demonstrate to area farmers how to build compost piles.

3.) Demonstrate to area farmers how to utilize the compost to increase organic matter in their soil.

Approach

The compost piles will be housed on a demonstration farm in wire-mesh sided structures with concrete floors and tin roofs. Piles will be turned regularly. Temperature, humidity and pH will be monitored to ensure adequate composting. Compost will be used on participating farmers' fields.

Outreach

Farmers from the area will be invited to attend workshops about composting through notices posted in local Extension and NRCS offices. Farmers who cultivate fragile land on the lake shore will be visited by project participants who will inform them of the projects results. Workshops will be offered monthly at the demonstration farm facilities. With the help of cooperating government agencies, printed material will be produced covering composting and organic farming methods.

Project area

Composting

Project duration

July 1995-Dec. 1998

Budget:

SARE	$10,000
ACE	
Matching	$20,400

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Lagoon Effluent as a Nutrient Source in Integrated Cropping Systems

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Livestock waste and lagoon effluent have not been used in Mississippi for application to growing row crops nor have soils been monitored after effluent application to pastures. These waste products must be handled properly to prevent contamination of streams and groundwater. Livestock waste and lagoon effluent have the potential to serve as a source of fertilizer and/or supplemental water when used correctly.

In 1993, the producer installed a new lagoon to alleviate overcrowding of the pre-existing lagoons on his farm. A solid waste structure was then built to hold dry cattle manure. In 1994 a structure was built to store fresh water for use on crops or pasture.

As the producers began to use the effluent and manure generated on their farm they found that little was known about proper rates of application or the best time of year to apply lagoon water or solid manure to a growing crop. This project will generate information that is needed on the safe use of these materials if they are to be used on sustainable row crop and pasture systems.

Objectives

1.) Test and monitor lagoon effluent to be used on corn and pasture.

2.) Determine proper application rates for swine lagoon effluent on corn and pasture.

3.) Determine proper application rates for cattle manure on corn and pasture.

4.) Determine best times of year to apply effluent and manure to corn and pasture.

Approach

Information on the safe application of swine lagoon effluent and cattle manure to corn will be determined. At the time of project initiation, extra pipe will be installed to vary the application rates of lagoon water and fresh water. Tissue samples of corn plants and grass crops will be taken along with samples of swine lagoon water and cattle manure.

Samples will be taken throughout a 120-acre corn field to determine the consistency of lagoon water as an entire lagoon is emptied during a single crop year. Application rates of swine lagoon water and cattle manure will be monitored throughout the growing year.

Outreach

Results will be communicated through joint agency on-farm field days and individual farm tours. Results will also go to the Extension office for inclusion in newsletters. A statewide Extension television program called *Farmweek* will provide features on the results.

Project area

Waste management

Project duration

July 1995-Dec. 1998

Budget:

SARE	$7,938
ACE	
Matching	$45,200

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Management of Artificial and Restored Wetlands to Improve Water Quality

Project Coordinator

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Wet detention basins are used to hold water and gradually release it, slowing runoff from agricultural areas into ecologically sensitive areas, including bodies of water. The slower runoff is often lower in agriculturally loaded nutrients than if it had run directly into the sensitive area.

Many citrus growers and agricultural growers lack specific knowledge of the actual water quality improvements and ecosystem benefits that wet detention basins provide to agricultural operations. Growers also are skeptical that sustainable methods can be implemented in a manner that is both cost-effective and enhances product quality. While growers understand how field practices affect their product output and cash income, many have far less understanding of how they can affect the environment through sound management of wet detention basins under their management.

Objectives

1.) Reduce nutrient loads entering a water body through the restoration of an ecologically diverse wetland serving as a wet detention basin.

2.) Restore wetland functions and reduce direct pumping of drainage water into the wetland.

3.) Educate growers on the use of a wet detention basin.

Approach

The project will restore a 10.3-acre agricultural retention area and will include one shallow freshwater marsh, a hardwood swamp, a hardwood hammock, a native palm hammock, two deep ponds, and a transitional hydric flatwoods area.

Excavation and land grading will be designed to route pumped water from the grove through the different wetland types and into a major drainage canal. Vegetated broad-crested weirs will be used where possible for controlling water movement within the retention area.

Monitoring of water quality will be performed periodically for three years after wet detention basin installation. Monitoring of vegetation changes will be recorded with still photography and video by the Water Management District and the landowner for future reference and for educational activities.

Outreach

Field days are scheduled for months 16 and 36 of the project and at 48 months, one year after project completion. The field days will be directed toward landowners, conservation groups, consultants, local state and federal agencies, citrus growers and the general public. In addition, public outreach will include press releases, journal articles and Extension publications.

Project area

Wetland management

Project duration

July 1995-Dec. 1999

Budget:

SARE	$10,000
ACE	
Matching	$140,200

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Improving Quality of Slaughter Hogs as a Marketing Strategy for Small Producers

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County Agent
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County Agent
All Cooperative Extension

The Bluegrass Pork Producers Association in East Central Kentucky is devoted to improving swine production through education and marketing. Because of a change in the marketing structure of slaughter hogs and the closure of two Kentucky packers, smaller producers have been forced to contract with low-volume auction markets. The lower volume markets pay them less than direct-market truckload lots to larger packers. By improving carcass quality, the producers involved with the project hope to receive higher prices from the lower volume auction markets.

Objectives

1.) Demonstrate the utility of ultrasound technology to improve carcass quality in slaughter hogs.

2.) Improve quality of slaughter hogs in the Bluegrass Pork Producers Group.

3.) Improve breeding consistency of swine in the Bluegrass Pork Producers Group.

Approach

Data will be collected on fatback content and depth, loin depth and percent lean of each animal by Extension personnel using ultrasound technology. Breeding stock will be evaluated two times the first year and once each the following two years. This information will be used to analyze the characteristics of participating producers' hogs and improve breeding and marketing.

Outreach

Project results will be presented at area farm demonstrations. Ultrasound demonstrations will be made to area 4-H and FFA organizations. One field day will be held halfway through the project and another at project completion.

Project area

Swine production

Project duration

July 1995-Dec. 1998

Budget:

SARE	$9,150
ACE	
Matching	$17,300

SARE/ACE
Sustainable Agriculture Research and Education
Agriculture in Concert with the Environment
Southern Region

PG95-32
Annual Report
December1995

Native Pecan Orchard Management Using Best Management Practices

Project Coordinator

Bill Wilson
Rt. 1 Box 486
Lewisville, AR 71845

Cooperators

Joe Vestal
Extension Agent
Terrance Kirkpatrick
Plant Pathologist
Cooperative Extension

Jim Barnes
ASCS

Native pecan trees predominate in the Red River Bottoms of Arkansas and are typically unmanaged. Since native pecans do not require extensive use of pesticides, as improved varieties do, production of these groves can potentially increase with only minor changes such as the application of fertilizers and the removal of plant debris under them. Production and harvest of native pecans in the area could potentially provide significant supplemental income for producers.

Objectives

1.) Identify native pecan trees capable of bearing marketable nuts.

2.) Demonstrate management practices in native pecan orchards to increase production.

Approach

The producers will identify individual native pecan trees capable of bearing nuts of marketable value. Designated areas of identified trees will be used as demonstration sites. Tissue and soil samples for analysis will be collected around the trees at these sites. Fertilizer will be applied to designated trees on the demonstration sites. The nuts will be harvested, and their quality will be evaluated.

Outreach

Project results will be published in the *Delta Farm Press*, *Arkansas Farmer* and the *Lafayette County Democrat*. A field day will be held to teach local producers how to increase native pecan production on their farms.

Project area

Pecan management

Project duration

July 1995-Dec. 1997

Budget:

SARE	$5,986
ACE	
Matching	$13,700

SARE/ACE
Sustainable Agriculture Research and Education
Agriculture in Concert with the Environment
Southern Region

PG95-33
Annual Report
December1995

Cover Crops in Integrated Vegetable Production Systems

Project Coordinator

Charles Wingard
Howard Rawl
W.P. Rawl & Sons Farms
518 Walter Rawl Rd.
Lexington, SC 29072

Ph: (803) 359-3645

Cooperators

Stephen Lewis
Nematology
Anthony Keinath
Plant Pathology
Wilton Cook
Horticulture
Clemson University

Douglas Deaderick
District Soil Conservation
Lexington County
South Carolina

Lexington County, South Carolina is a major vegetable producing area. Around 4,000 acres of collard greens, green onions, squash, tomatoes and beans are produced annually. Cover crops are needed to reduce soil losses and improve soil conditions. The current vegetable cropping systems used on much of the land in the county contribute to the loss of seven to eight tons of soil per acre annually. The soils are deep and sandy, requiring high irrigation rates. Because of this, high rates of nitrogen are applied and lost.

Winter cover crops could be used to reduce erosion. Cover crops would also reduce nitrogen losses (by using a nitrogen-fixing species less nitrogen fertilizer would have to be applied), improve organic matter levels, soil texture, soil structure and water-holding capacity.

Cover crops can potentially control certain diseases through their place in a rotation, but some studies have indicated that the incidence of root-knot nematodes and diseases caused by *Pythium* and *Rhyzoctonia* can increase following certain cover crops.

Objectives

1.) Test treatments of the cover crops: rye, oats, rye + crimson clover, rye + cahaba vetch, crimson clover, cahaba vetch, hairy vetch, Austrian winter pea, arrowleaf clover and a fallow, to control erosion and improve soil fertility.

2.) Determine if any of these cover crops encourage the growth of plant diseases caused by *Rhyzoctonia* and *Pythium.*

Approach

The cover crop treatments will be planted in a randomized complete block design replicated four times. Soil will be tested for pH, nitrogen, physical properties, nematodes and *Rhyzoctonia* and *Pythium*. Crop dry weight, N content and disease incidence will be observed and recorded.

Outreach

A field day will be sponsored by local seed companies in April each year of the project. An Extension fact sheet and newsletter will be produced and disseminated.

Project area

Integrated systems

Project duration

July 1995-Dec. 1998

Budget:

SARE	$9,285
ACE	
Matching	$11,315

SARE/ACE
Sustainable Agriculture Research and Education
Agriculture in Concert with the Environment
Southern Region

PG95-34
Annual Report
December1995

Hydroponic Vegetable Production in Conjunction with a Trout Farming Operation

Project Coordinator

Carl Zietlow
Best Trout and Organic Farm
3013 White Oak Creek Rd.
Burnsville, NC 28714

Ph: (704) 675-5440

Cooperators

Skip Thompson
Aquaculture
Jeff Henshaw
Trout Research
Jeanine Davis
Vegetable Specialist
All NCSU Extension

Carl Niedziela
Horticulture
NCA&T Extension

Johnny Hensley
Horticulture
County Extension

Jeana Myers
Partners in Agriculture

Marjorie Bender
Carolina Farm Stewardship Assoc.

Sarah Slover
NC Greenhouse Vegetable Growers Assoc.

Aurelia Stone
NC Trout Growers Assoc.

Debra Sloan
Aquaculature
NC Divsion of Aquaculature and Natural Resources

Producers:
William Cable
Pat Battle

Project area

Aquaculture

Project duration

July 1995-Dec. 1998

Budget:

SARE	$9,975
ACE	
Matching	$6,425

North Carolina is the second-largest producer of commercially raised trout after Idaho. Trout farms must comply with effluent discharge regulations administered by the Division of Environmental Management within the Department of Environment, Health and Natural Resources. While most trout farms are able to comply with current regulations, the potential for more stringent regulation exists. This producer is situated on a tributary of the South Toe River which has a Clean River designation.

Effluent from trout farms is rich in nutrients. These nutrients can be a source of pollution if allowed to enter a waterway or they can be a source of nutrients for effluent irrigated plants.

Objectives

1.) Use the drainage effluent from trout ponds to fertigate vegetables and greens.

2.) Adapt tobacco-grower static float-bed and tray system for greenhouse vegetable growing.

3.) Adapt flow-through greenhouse hydroponic system to use drainage effluent from trout ponds.

Approach

The producer will prepare a greenhouse site, construct two small greenhouses (one for a static system and one for a flow-through system) and install hydroponic and float-bed systems. Once the greenhouses and the float-bed systems are operational, the nutrients, air and water temperatures from the pond and the raceway systems will be tested. Thereafter, nutrient levels and water and air temperatures will be taken monthly. Vegetables and greens will be grown in these systems throughout the three years of the project.

Outreach

The information produced from this project will be communicated through workshops and conferences with trout producers in the area. Articles will be produced for Extension newsletters and the bimonthly newsletter of Rural Voice for Peace.

Expanding Horizons

When both the Producer Grant and the Extension Training Grant programs kicked off in 1994, a total of 26 new projects were immediately added to the Southern Region along with 13 new Research and Education projects. These 39 new projects joined a portfolio of about 50 Research and Education projects already in progress from previous years' funding. Since all of the projects are administered by a three-person staff in the Georgia office, it didn't take long to determine that more help was needed. That help came just in time.

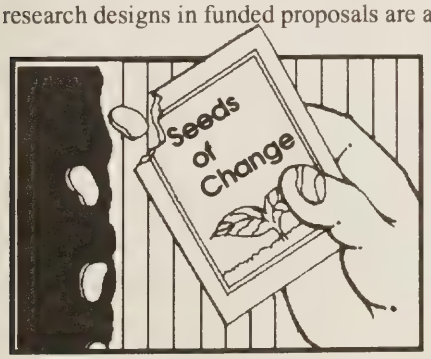
The Extension Training management team was selected from proposals submitted in 1994. When the time came for issuing the 1996 call for proposals, that team of Roger Crickenberger (NCSU), Jim Lukens (ATTRA) and John O'Sullivan (NCA&T) was ready for action and initiated the process from North Carolina.

With Extension Training up and running, a search was started for someone to coordinate the Producer Grant projects – someone with a sustainable agriculture science background who knows how to both listen and talk to farmers.

Dr. John C. Mayne's credentials stood out in the field of candidates. He grew up in Florida and earned degrees at three southern universities, the latest being a doctorate in agroforestry from the University of Florida. His dissertation research was conducted in Costa Rica on nutrient uptake in systems used by farmers there. But it is his experience working with limited-resource farmers in Guatemala and his own small hog operation near Tallahassee that gives him rapport with farmers.

"The best thing to come out of those experiences," says Dr. Mayne, "is finding out that being self-sufficient and less dependent on outside resources can help you ride out the vagaries of nature and markets."

As Producer Grant specialist, he will assist producers in everything from accurately submitting the proposal application to ensuring that research designs in funded proposals are appropriate. He will also visit projects once they are up and running, maintaining contact with the producer until the research is complete and final results are reported and disseminated to other farmers.



Readers help design a winner

In its first year of production *Common Ground*, the quarterly newsletter for Southern Region SARE/ACE, won the Gold Award for Newsletters presented by the Critique and Awards Program of the Agricultural Communicators in Education.

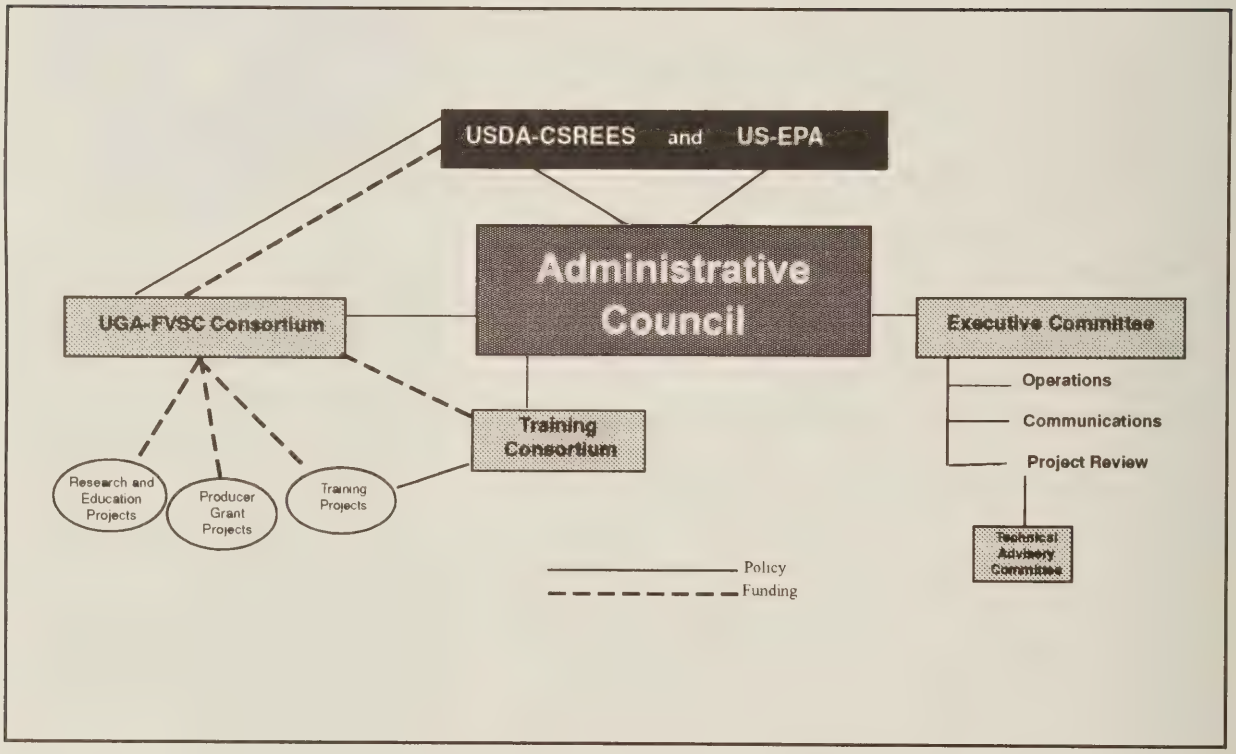
Editor Gwen Roland gives much of the credit to *Common Ground* readers who named the newsletter in a contest and who continue to help decide its content and design through their participation in yearly surveys.

"I don't know if their abundant input is due to the natural loquaciousness of Southerners or if *Common Ground* readers just have a lot of time on their hands, but their answers never stay in the blanks I provide on the survey form," says Roland. "I have to turn the pages all around to read in the margins and follow the arrows to the back where they write all over the address label."

Awards are nice, according to Roland, but the greatest measure of *Common Ground*'s success comes when Extension agents or farmers call to request permission to reprint an article in their own newsletter. "When such people think my articles are relevant enough to take up space in their publications, I know *Common Ground* is doing its job," she says.

Common Ground, in its second year of publication, is still following the original format of capsule stories about SARE/ACE projects. At the end of each story is an offer for a full report to anyone interested in more information about that project. The mailing list has increased from 1,300 to 4,500 in one year.

Organizational Chart



Organizational Structure

A program apart

Regional autonomy and end-user participation are qualities that set SARE/ACE apart from other competitive grants programs. Even though Congress decides the amount of funding for the national program, each regional administrative council determines the process by which the funds are administered for its prescribed states and territories. They determine priority areas and other guidelines for each funding year's focus. They also appoint the technical review committees that invest the hours of reading and evaluating proposals necessary for fair and open competition.

Who are the people comprising the administrative councils and technical review committees in each region? They are a cross section of the people who benefit from the results of SARE/ACE research. They include researchers and Extensionists, farmers and ranchers, representatives of government agencies and agribusiness, members of grassroots agricultural organizations and other non-governmental agencies. They are the people waiting for SARE/ACE research results that they can use to develop economically, environmentally and socially sound agricultural methods to meet our nation's food and fiber needs.

Process in action

In the Southern Region more than 100 people review the preproposals each year. Their evaluations help determine which preproposals will be selected for development into full proposals. The full proposals are read and evaluated by the Technical Advisory Committee.

The Technical Advisory Committee members meet to debate the merits of each proposal and compile a list of those recommended for funding. The proposals recommended for funding by the Technical Advisory Committee are then reviewed by the Project Review Committee of the Administrative Council and referred to the Administrative Council for final approval.

Program Contacts

Rob Myers
SARE Program Director
USDA/CSREES
Washington DC

Harry W.Wells
ACE Program Director
Pollution Prevention Office - USEPA
Washington DC

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Gerald F. Arkin
Southern Region SARE/ACE Coordinator
Georgia Experiment Station
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Fort Valley, GA

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Roger Crickenberger
Training Consortium Management
North Carolina State University
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Jim Lukens
Training Consortium Management
ATTRA
Fayetteville, AR

John O'Sullivan
Training Consortium Management
North Carolina A&T University
Greensboro, NC

Administrative Council

1995 Membership

Adell Brown
Southern University
Louisiana

D.C. Coston
Oklahoma State University
Stillwater, OK

David Foster
Cooperative Extension
Arkansas

Tim Hale
US Geological Survey
Georgia

Alex Hitt
Producer
North Carolina

James Horne
Kerr Center for
Sustainable Agriculture
Oklahoma

John Ikerd
USDA/Extension Service
Missouri

Arnold King
Natural Resource Conservation
Service
Texas

Rick Kocurek
Producer
Texas

Bryce Malone
Dept. of Agriculture & Forestry
Louisiana

Lorna McMahon
Producer
Tennessee

Rob Myers
SARE Program Director
USDA/CSREES
Washington, DC

Charles A. Onstad
USDA/ARS
Texas

Charles Panton
North Carolina A & T
North Carolina

Jerry Pennick
Federation of Southern Cooperatives
Georgia

Walter Rowden
Producer
Arkansas

Melbah Smith
MS Association of Cooperatives
Mississippi

Tom Trantham
Producer
South Carolina

Gene Turpin
Producer
Kentucky

Noble Usherwood
Potash and
Phosphate Institute
Georgia

Donald Voth
Univ. of Arkansas
Arkansas

Harry Wells
Pollution Prevention Office
USEPA
Washington, DC

Savanah Williams
Producer
Virginia

Duties

The Southern Region SARE Administrative Council is responsible to the Secretary of Agriculture through the CSREES-ES partnership. Specific responsibilities are to:

* Appoint a regional host institution and regional coordinator subject to the approval of the USDA;
* Make recommendations to the USDA concerning research and education projects that merit funding;
* Promote sustainable agriculture research and education programs in the Southern Region;
* Establish goals and criteria for the selection of projects within the Southern region;
* Appoint a Technical Advisory Committee for evaluation of proposals for projects to be considered for funding
* Review and act upon the recommendations of the Technical Advisory Committee and coordinate its activities with the host institution;
* Prepare and make available an annual report concerning Southern Region activities in sustainable agriculture.

Membership

Terms of membership are for three years, with approximately one-third rotating off each year. The membership of the Administrative Council includes:

* Farmers/ranchers practicing sustainable agriculture, including farmers/ranchers representing Best Utilization of Biological Applications and representing Integrated Management Systems;

* Nonprofit organizations with demonstrable expertise in sustainable agriculture including organizations representing Best Utilization of Biological Applications and organizations representing Integrated Management Systems;

* Agribusiness with demonstrable expertise in sustainable agriculture

* Representatives from the following:
  - USDA Agriculture Research Service
  - USDA Cooperative State Research Education and Extension Service
  - US Environmental Protection Agency
  - Natural Resource Conservation Service
  - State agency representing sustainable agriculture
  - State agricultural experiment stations
  - State Cooperative Extension Services
  - US Geological Survey

* Other persons knowledgeable about sustainable agriculture and its impact on the environment and rural communities.

Technical Advisory Committee

Duties

The primary goal of the committee is to provide guidance to the Southern Region SARE/ACE program concerning the technical merit of proposals and projects. The committee provides recommendations for funding based on technical merit through the Project Review Committee to the Administrative Council.

* Evaluate preproposals and full proposals submitted to the SARE/ACE program.

* Participate in project and program reviews.

* Work with the Project Review Commmittee and Host Institution on developing appropriate proposal and project evaluation guidelines.

Membership

Terms of membership are for three years, with approximately one-third of the members rotating off the committee each year.

Members are appointed by the Adminstrative Council from the following sectors:

* Farmers/ranchers who practice sustainable agriculture, including farmers/ranchers representing Best Utilization of Biological Applications and representing Integrated Management Systems;

* Nonprofit organizations with demonstrable expertise in sustainable agriculture including organizations representing Best Utilization of Biological Applications and organizations representing Integrated Management Systems;

* Agribusiness with demonstrable expertise in sustainable agriculture

* Representatives from the following:
  - USDA Agriculture Research Service
  - USDA Cooperative State Research Education and Extension Service
  - US Environmental Protection Agency
  - Natural Resource Conservation Service
  - State agency representing sustainable agriculture
  - State agricultural experiment stations
  - State Cooperative Extension Services
  - US Geological Survey

* Other persons knowledgeable about sustainable agriculture and its impact on the environment and rural communities.

1995 Membership

Samuel Bass
South Carolina State Univ. Ext.

Larry Butler
SCS-SNTC
Texas

Viviana Carro
University of Puerto Rico

Barry Colley
Arkansas Land & Farm Devel. Corp.

Billy Higgenbotham
Prairie View A&M
Coop. Ext. Service
Texas

Christopher Hunte
Southern University
Louisiana

Larry Jeffries
Producer
Kentucky

Jim Joyner
Producer
Tennessee

Ira Linville
EPA, Region IV
Georgia

Richard Lowrance
USDA
Georgia

Glenn Mackie
County Extension
Kentucky

Teresa Maurer
ATTRA
Arkansas

George Naderman
North Carolina State Univ.

Mack C. Nelson
Fort Valley State College
Georgia

Manuel Palada
Univ. of the Virgin Islands

Jim Pease
Virginia Tech

David Redhage
Kerr Center
Oklahoma

Glenn Richardson
Producer
Texas

Craig Rothrock
University of Arkansas

Edward Segerson
North Carolina A & T

C. W. Seo
North Carolina A & T

John R. Simpson
South Carolina State College

Tina Gray Teague
Arkansas State University

Jim Thomas
Mississippi State Univ.

Ted Whitwell
Clemson University
South Carolina

Jim Worstell
Delta Land and Community, Inc.
Arkansas

Robert Zabawa
Tuskegee University
Alabama

Active SARE Projects

Project #	Project Title	Lead Institution	Project Coordinator	SARE Funds	Matching Funds
LS91-37	Low-input Crop and Livestock Systems for Southeastern United States	Virginia Tech	Joe Fontenot	$ 360,000	$ 95,180
LS91-40.1	Winter Legume Cover Crops for Pest and Fertility Management in Cotton	University of Arkansas	Craig Rothrock	$ 104,000	$ 89,280
LS92-45	Use of Organic Nitrogen Sources for Sweet Potatoes: Production Potential and Ecnomic Feasibility (Also AS92-6)	North Carolina State Unversity	Wanda Collins	$ 105,000	$ 44,380
LS92-46	Development of Cropping Systems for Nematode Management on Agronomic and Horticulture Crops	University of Florida	Don W. Dickson	$ 155,000	$ 84,350
LS92-48	Developing Environmentally Sound Poultry Litter Management Practices for Sustainable Cropping Systems	Texas A&M	D. Ron Earhart	$ 140,000	$ 6,669
LS92-49	Organic Soil Amendments of Agricultural By-Products for Vegetable Production Systems in the Mississippi Delta Region	Arkansas State University	Tina Teague	$ 140,000	$ 64,579
LS93-51	Warm-Season Forage Grasses as Rotations for Sustaining Profitable Peanut Production	Auburn University	R. Rodriguez-Kabana	$ 183,000	$ 48,500
LS93-52	Utilization of Dairy Manure in Low-Input, Conservation Tillage Animal Feed Production Systems	University of Tennessee	Michael Mullen	$ 90,635	$ 36,123
LS93-53	Sustainable Whole Farm Grain/Silage Production Systems for the Southeast	Auburn University	Wayne Reeves	$ 240,639	$ 218,600
LS93-54	Evaluation of Low-Input, No-Till, No-Herbicide Continuous Grazing System for Grazing Cows	Clemson University	Jean Bertrand	$ 118,911	$ 62,700
LS93-55	Cover Crop Integration into Conservation Production Systems for Cotton and Sorghum	USDA/ARS	Seth Dabney	$ 135,540	$ 117,040
LS93-56	Using Soldier Flies as a Manure Management Tool for Volume Reduction, House Fly Control and Feedstuff Production (Also AS93-9)	University of Georgia	Craig Sheppard	$ 2,150	$ 513
LS94-57	Disease and Insect Management Using New Crop Rotations for Sustainable Production of Row Crops	University of Georgia	Barry Cunfer	$ 152,200	$ 52,614
LS94-58	Post-CRP Land Management and Sustainable Production Alternatives for Highly Erodible Lands in the Southern Great Plains	USDA/ARS	Thanh Dao	$ 196,100	$ 90,000
LS94-59	Assessing the Impact of Beneficial Insects on Organic Farms (Also AS94-13)	North Carolina State University	George Kennedy	$ 17,735	See AS94-13

Active SARE Projects

Project #	Project Title	Lead Institution	Project Coordinator	SARE Funds	Matching Funds
LS94-60 LS95-60.1	Integration of Animal Waste, Winter Cover Crops, and Biological Antagonists for Sustained Management of Columbia Lance and Other Nematodes on Cotton (Continued as LS95-60.1)	North Carolina State University	Kenneth Barker	$ 46,721 96,691	$ 12,356 24,593
LS94-61	Integrating Sustainable Forestry into Whole Farm Management of Minority and Limited-Resource Landowners in Three Regions of Arkansas	Winrock International	Jim Wimberly	$ 246,710	$ 159,086
LS94-62	Intercropping Small Grains and Lupin for Sustainable On-Farm Utilization	Auburn University	Edzard van Santen	$ 143,151	$ 164,759
LS94-63	Regional Center for Sustainable Dairy Farming	North Carolina State University	Steve Washburn	$ 180,497	$ 127,924
LS94-64	Development of Sustainable Area-Wide Weed Management Practices for Improved Land Utilization (Continuation of AS93-8)	University of Tennessee	Jerome Grant	$ 3,760	See AS-93-8
LS95-65	Wildlife Enhancement (Also AS95-18)	North Carolina State University	Peter Bromley	$ 98,205	See AS95-18
LS95-66	Control for Citrus Mites (Also AS95-19)	Univ. of Florida	Carl Childers	$ 50,512	$ 52,000
LS95-67	The Development of Pasture-Based Swine Production Systems for Limited Resource Farms in the Mississippi Delta	Arkansas Land and Development Corporation	Barry Colley	$ 274,412	$ 68,852
LS95-68	Using Farm Family Case Studies to Teach Sustainable Agriculture	University of Tennessee	Tim Cross	$ 146,630	$ 137,090
LS95-69	Managing Soil Phosphorous Accumulation From Poultry Litter Application Through Vegetable/Legume Rotations	Texas A&M	D.R. Earhart	$ 135,000	$ 90,813
LS95-70	Effects of Organic and Chemical Fertility Inputs on Soil Quality In Limited Resource Vegetable Farms	Virginia Tech	Greg Evanylo	$ 184,319	$ 79,351
LS95-71	Developing Municipal/On-Farm Linkages for On-Farm Composting and Utilization of Yard Wastes	Virginia Tech	Greg Evanylo	$ 69,167	$ 24,522
LS95-72	Agronomic and Economic Benefits of Intercropping Bean with Banana	University of Puerto Rico	Lii-chyuan Liu	$ 98,845	$ 50,239
			Total SARE funding	$3,915,530	$1,950,113

Active ACE Projects

Project #	Project Title	Lead Institution	Project Coordinator	ACE Funds	Matching Funds
AS92-1	An Integrated Technological and Marketing Strategy to Make Broiler Production More Sustainable	Winrock International	Fee Busby	$ 200,000	$ 101,409
AS92-2	Habitat Enhancement for Beneficial Insects in Vegetable and Fruit Systems	Rodale Institute	Janet Bachmann	$ 200,000	$ 79,975
AS92-4	CROPS, the Crop Rotation Planning System, for Whole-Farm Environmental and Economic Planning	Virginia Tech	Nicholas Stone	$ 140,000	$ 88,247
AS92-6	Use of Organic Nitrogen Sources for Sweet Potatoes (Also LS92-45)	North Carolina State University	Wanda Collins	$ 15, 000	$ 6,340
AS93-7	Evaluation of Recycled Paper Mulch as an Alternative to Black Plastic Mulch in Vegetable Horticulture	VA Assoc. for Biological Farming	Mark Schonbeck	$ 40,000	$ 10,100
AS93-8	Development of Sustainable Area-Wide Weed Management Practices for Improved Land Utilization (Continued as LS94-64)	University of Tennessee	Jerome Grant	$ 161,240	$ 133,000
AS93-9	Using Soldier Flies as a Manure Management Tool for Volume Reduction, House Fly Control and Feedstuff Production	University of Georgia	Craig Sheppard	$ 49,100	$ 12,300
AS93-10	Use of Poultry Litter or Manure for Root-Knot Nematode Management on Vegetables and Field Crops(Continued from LS91-39A)	University of Arkansas	David Miller	$ 100,000	$ 64,043
AS93-11 AS94-11.1	Use of Poultry Litter or Manure for Root-knot Nematode Management on Vegetables and Field Crops (Continued as AS94-11.1)	Clemson University	Bruce Fortnum	$ 99,900 $ 46,792	$ 81,000 $ 54,000
AS93-12	Waste Management Systems for Loafing Areas in Dairies	Clemson University	David Brune	$ 68,613	$ 26,540
AS94-13	Assessing the Impact of Beneficial Insect Populations on Organic Farms (Also LS94-59)	North Carolina State University	George Kennedy	$ 37,207	$ 14,068
AS94-14	Forage, Biomass and Biogas Integrated Systems for Animal Waste Management	Texas Agricultural Experiment Station	Matt Sanderson	$ 101,180	$ 157,894
AS94-15	Integrated Grazing Systems Planning and Decision Support for Improved Sustainability and Environmental Quality	University of Kentucky	Larry Turner	$ 27,500	$ 67,115
AS94-16	Development of Guidelines for and Demonstration of Efficient Treatment of Swine Lagoon Wastewater by Constructed Wetlands	Auburn University	Tom A. McCaskey	$ 130,325	$ 78,553

Active ACE Projects

Project #	Project Title	Lead Institution	Project Coordinator	ACE Funds	Matching Funds
AS95-17	Transitioning to Sustainable Methods in Sugarcane Farming	Northside Planting Co.	Jackie Judice	$ 15,000	$ 6,000
AS95-18	Wildlife Enhancement and Education as Catalyst in the Widespread Implementation of Sustainable Ag Practices (Also LS 95-65)	North Carolina State University	Peter Bromley	$ 75,000	$202,904
AS95-19	Development of Biological Control Methods for Citrus Rust Mites and Spider Mites on Florida Citrus Utilizing Predaceous Arthropods (Also LS95-66)	University of Florida	Carl Childers	$ 75,000	$ 35,000
AS95-20	The Utilization of Natural Enemies, Viral Insecticides and Improved Information Delivery for Management of Lepidopterous Pests in Developing Transgenic Cotton	Clemson University	Sam Turnipseed	$ 37,820	$ 46,759
AS95-21	Reduced Risk Cockroach Control in Confined Animal Production	North Carolina State University	Coby Schal	$ 38,840	$ 15,889
AS95-22	Biological Control of Silverleaf Whitefly and Fungus Gnat in Poinsettia Production	University of Georgia	Mary Harris	$ 45,389	$ 11,250
AS95-23	Increasing Acceptance of Low Input Landscapes for the Southeast	University of Georgia	S. Kristine Braman	$ 36,826	$ 15,980
AS95-24	Identifying Pesticides Most Compatible With Parasites of the Citrus Leafminer	University of Florida	Marjorie Hoy	$ 33,125	$ 24,487
			Total ACE funding	$ 1,773,857	$1,372,853

Active Producer Projects

Project #	Project Title	State	Project Coordinator	SARE Funds	Matching Funds
PG94-1	Controlling Aphids With Harmonia Lady Beetle in Pecan Orchards	Texas	Texas Pecan Growers Association	$4,600	$4,500
PG94-4	Nutrient Evaluation and On-site Composting of Poultry Litter	Georgia	Andy Hickox	$3,000	$2,275
PG94-5	Vegetable Marketing Strategies for a Small Farm Co-op	South Carolina	Sea Islands Farm Co-op	$10,000	$1,850
PG94-6	Insect Pest Management for Cotton	Georgia	Benny Johnston	$8,700	$12,950
PG94-7	Perennial Warm Season Grasses as Summer Pasture	North Carolina	Norman and Karen Jordan	$ 733	$ 1,767
PG94-8	Meat Goats for Weed Control and Alternative Income in Cattle Operations	North Carolina	Tony Kern & Linda Creekmore	$2,020	$4,200
PG94-10	Site Specific Applications of Seed/Fertilizer/ Chemicals	Texas	Ricky Meinen	$10,000	$20,900
PG94-11	Clover Clippings as Replacement for Chicken Litter in Compost	Alabama	Jean Mills	$6,160	$6,040
PG94-12	Swine Lagoon Management System	Tennessee	Kenneth Moore	$10,000	$20,550
PG94-13	Plant Shelters to Extend the Growing Season for Herbs	North Carolina	Richard Morgan	$3,550	$3,350
PG94-14	Cut Flowers as a Sustainable Agricultural Alternative	Oklahoma	Judy Schroeder & Vicki Stamback	$6,000	$3,100
PG94-15	Farmer-to-Farmer Transfer of Knowledge About Rotational Grazing	Arkansas	Luane Schroeder	$9,988	$22,133
PG94-16	Clover Cover Crops, Weed Management and Consumer Tolerance to Insect Damage	South Carolina	Horace & Shaw Skipper	$4,710	$5,918
PG94-17	Shrimp Polyculture in Existing Farm Livestock Ponds	Kentucky	Mark & Carolyn Straw	$3,109	$1,850
PG94-19	Biological Control of Flower Thrips in Pepper Fields	Florida	Ted Winsberg	$9,950	$10,900
PG95-20	No-Till Vegetable Demonstration	Virginia	Linford Belcher	$8,300	$17,200
PG95-21	Pecan IPM Using Black-Eyed Peas as a Trap Crop	Texas	Kyle Brooksheir	$4,000	$4,098
PG95-22	No-Till Grain Production for Soil and Moisture Conservation	Oklahoma	Bob Dietrick	$9,818	$19,636
PG95-23	No-Till Cotton Production Using Best Management Practices	Mississippi	Charles Donald	$8,295	$53,280

Active Producer Projects

Project #	Project Title	State	Project Coordinator	SARE Funds	Matching Funds
PG95-24	Alternative Control of Soil Diseases in Vegetable Production	Virginia	Dennis Dove	$5,625	$4,060
PG95-25	Development of Potting Soil Mixes from Local Wastes	Florida	Steve Garrison	$9,600	$13,800
PG95-26	Testing the Efficacy of Alternative Methods of Whitefly Control in Organic Vegetable Production	Florida	Rosalie Koenig	$5,200	$1,875
PG95-27	High-Value, Small-Scale Sustainable Vegetable and Fruit Production Methods	North Carolina	Larry & Judy McPherson	$9,612	$4,942
PG95-28	Improving Tropical Soils by Utilizing Organic Wastes	Puerto Rico	Andre Rene Sanfiorenzo	$10,000	$20,400
PG95-29	Lagoon Effluent as a Nutrient Source in Integrated Cropping Systems	Mississippi	William Sansing	$7,938	$45,200
PG95-30	Management of Artificial and Restored Wetlands to Improve Water Quality	Florida	A. Glenn Simpson	$10,000	$140,200
PG95-31	Improving Quality of Slaughter Hogs as a Marketing Strategy for Small Producers	Kentucky	Bluegrass Pork Producers	$9,150	$17,300
PG95-32	Native Pecan Orchard Management Using Best Management Practices	Arkansas	Bill Wilson	$5,986	$13,700
PG95-33	Cover Crops in Integrated Vegetable Production Systems	South Carolina	Charles Wingard	$9,285	$11,315
PG95-34	Hydroponic Vegetable Production in Conjunction with a Trout Farming Operation	North Carolina	Carl Zeitlow	$9,975	$ 6,425
			Total Producer Grant funding	$215,304	$495,714

Four 1995 Producer Grant Projects amounting to $15,386 have been discontinued. Those funds will be used to support 1996 Producer Grant Projects.

Active Extension Training Projects

Project #	Project Title	Lead Institution	Project Coordinator	SARE Funds	Matching Funds
LST94-1	Southern Region Sustainable Agriculture Training Consortium	North Carolina State University	Roger Crickenberger	$199,620	$14,875
LST94-2	Environmentally and Economically Sustainable Use of Rangeland	Texas A&M University	J.F. Cadenhead	$72,570	$72,570
LST94-3	Management Intensive Grazing: Foundation of Sustainable Agriculture in the South	University of Southwestern Louisiana	H. Alan DeRamus	$63,461	$109,463
LST94-4	Sustainable Dairy Systems Manual and Training	University of Tennessee	Clark Garland	$90,000	$277,920
LST94-5	Sustainable Cotton Production for the South	Auburn University	Elizabeth Guertal	$10,000	$11,898
LST94-6	Extending Sustainable Agricultural Concepts and Practices to Traditional Agricultural Advisors	Clemson University	Jim Palmer	$11,700	$10,500
LST94-7	Evaluating Sustainability: Gaining Insights	University of Florida	Marilyn Swisher	$56,269	$13,467
			Total Extension Training funding	**$503,620**	**$510,693**

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Photo of Jean Mills by Carol Eichelberger

"We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."

Aldo Leopold, *A Sand County Almanac*

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Enthusiasm is a hallmark of participants in Extension Training Grants, the newest grant program in the SARE/ACE family. Extension personnel and other educators are eagerly signing up for seminars, workshops, farm tours and other educational events offered to train the trainers in sustainable agriculture.

In this photo, participants get the low down on the successful pest management system used by Hilton Rogers on his sweet corn farm in South Carolina (LST94-7). Photo by Jim Palmer.